THE ENGINEER.

The British Industries Fair at Birmingham.

The British Industries Fair at Birmingham.

THE British Industries Fair will, this year, we believe, be more interesting than usual, not merely on account of its greater extent but also through the essentially British spirit which is invading our factories. It is not our province to discuss economic politics on such an occasion, but there is good evidence that not only are the industrial people of this country using every effort to produce, and market, commodities that are in world-wide demand, but also to produce them at an economic price.

The extent to which the Fair is gaining in popularity as a means of advertising the products of our country may be gauged by the fact that, while in 1920, when the Birmingham section was first instituted, the floor area occupied amounted to only 85,000 square feet, it will cover this year 244,374 square feet, all under one roof, while there will be a number of other exhibits in the grounds outside, more or less protected from the weather, besides the section known as the "Quarry to Roads." This section, which is essentially devoted to civil engineering work, is designed to show British machines at work making roads, and other activities associated with road transport.

The Fair, it is hardly necessary to mention, is held, not only in Birmingham, but also in London at Olympia and at the White City; but, in view of the fact that the exhibits of engineering interest are concentrated in the Birmingham section, we shall devote our attention to it in exclusion of the others.

The Fair opens on February 20th, and will close on Friday, March 3rd.

RUSTON-BUCYRUS, LTD.

The "Quarry to Road" section of the Exhibition, which is held in the open ground surrounding the buildings, should be more interesting than usual this year. It will embrace a number of mechanical contrivances applied to civil engineering, among which there is to be the drag-line illustrated in Fig. 1. This machine, by Ruston-Bucyrus, Ltd., of Lincoln, is to be used in loading material into Hudson tip wagons drawn by an oil locomotive made by the Hunslet Company, of Leeds—these machines will be referred to later in our account of the Exhibition. The Ruston drag-line has a bucket with a capacity of ¾ cubic yard on a boom 35ft. long, and is of the same general character as similar machines by the same makers which have already been described in our columns. It is driven by a four-cylinder compression-ignition oil engine of 70 horse-power, and has a digging effort of approximately 7 tons as a drag-line, while it will pull 10 tons as a shovel and 12 tons as a drag-shovel. One of the outstanding features of the machine is the massive steel casting on which it is founded, and which prevents it being racked out of shape in going over rough ground and causing the driving shafts to seize up in their bearings. The machine has a good clearance above the ground, and the main shaft for driving the caterpillar tracks is readily accessible. It is not necessary for the driver to have any help in steering the machine, as the two tracks are put into operation either independently, or together, by means of a simple slewing action. The total weight of the machine is 21 tons.

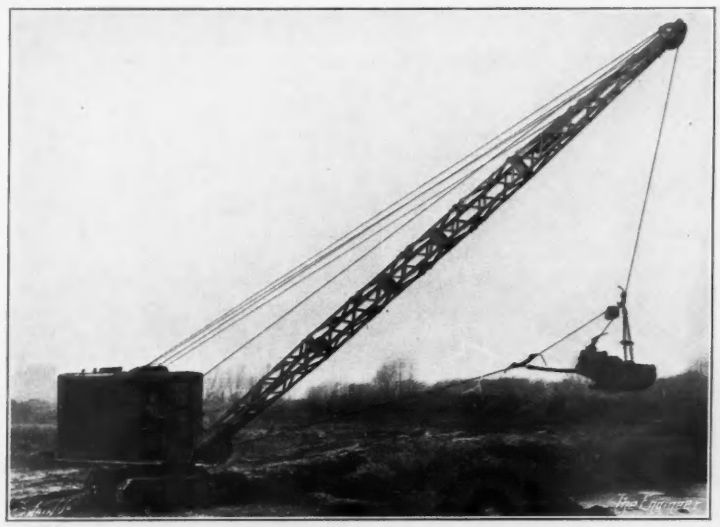


FIG. 1—¾-CUBIC YARD DRAGLINE EXCAVATOR—RUSTON

Inside the Exhibition buildings the Ruston Company is to have another stand devoted to the display of photographs of excavating work and data.

WALLIS AND STEEVENS, LTD.

Another of the pieces of equipment to be shown in the "Quarry to Road" section will be the 2½-ton motor roller, represented in Fig. 2, by Wallis and Steevens, Ltd., of Basingstoke. This machine is driven by a four-cylinder, side-valve, petrol engine, with cylinders 75 mm. bore by 102 mm. stroke, developing 14½ B.H.P. when running at a speed of 1150 r.p.m. It has a spur gear driving transmission, of which the shafting runs in ball bearings, giving speeds of 1, 1½, 2½ and 4 miles per hour in each direction. The back rollers are mounted on stub shafts, which are free to rock to conform to the camber of the road surface, but are restrained by springs, so that the most even loading possible is maintained. The rims of the rolls are detachable and can be reversed, so that the total rolling width can be reduced from 4ft. 2½in. to 3ft. 6½in. The rolls themselves are 3ft. in diameter by 15in. wide, and the front roll is 2ft. 9in. by 2ft. As will be seen from the engraving the front roll is mounted in a forked carriage that gives an underslung effect and prevents sideslip. The steering gear is of the machine-cut type, and there are two powerful hand brakes on the back rolls.

BARFORD AND PERKINS, LTD.

Barford and Perkins, of Rochester, also, will have some rollers at work at the Fair, all driven by internal combustion engines. They include those illustrated by Figs. 3, 4 and 5. The first weighs 10 tons 14 cwt., and is driven by a two-cylinder heavy-oil engine giving 35 horse-power at 800 r.p.m. The engine has the characteristic that it can be throttled down to 200 r.p.m. and will still run steadily. The cylinders are 5 5/16 in. in diameter by 7⅞in. stroke, and the valves are of the overhead type. There is a dust-proof cover, which totally encloses the valve rockers. Each cylinder has its own fuel pump, a single-acting pump without stuffing-box and with automatic delivery and suction valves. The valves are of steel, having conical seats, the delivery valve being spring-loaded and the suction valves being closed by their own weight. The pump plunger is raised by a cam actuating a rocker lever and is returned by a spring. The maximum stroke of the pump is regulated by adjusting screws. An outside hand lever is provided

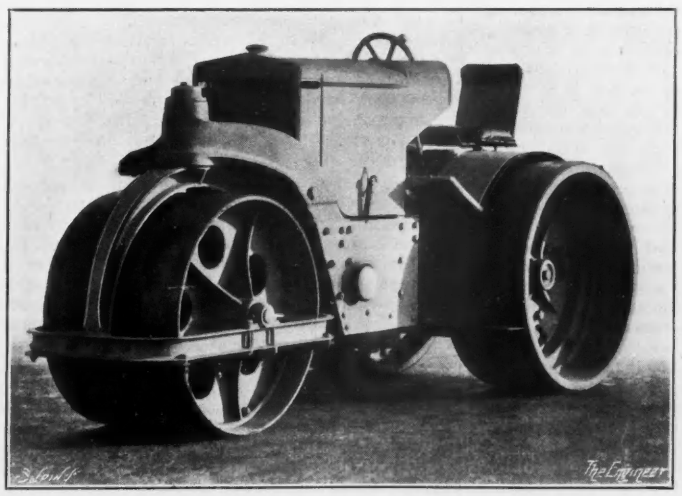


FIG. 2—2½-TON MOTOR ROLLER—WALLIS AND STEEVENS

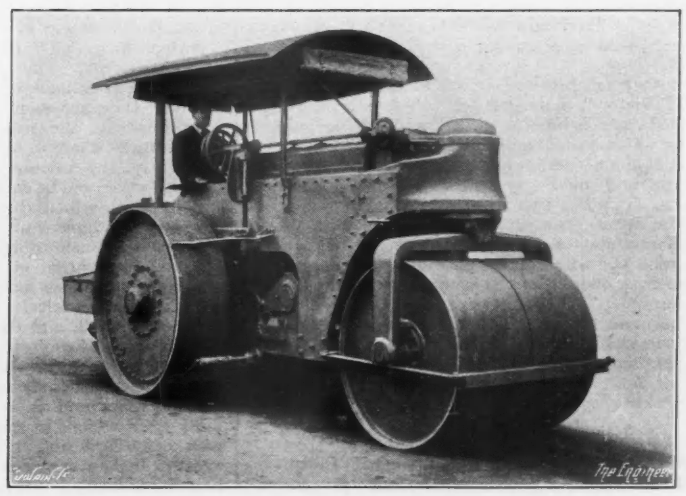


FIG. 3—10-TON MOTOR ROLLER—BARFORD AND PERKINS

for pumping by hand, the fuel pump pressure being 1000 lb. per square inch. A fuel filter and also a strainer are provided between the fuel tank and the pump suction. Each fuel pump delivers oil to its corresponding atomiser, which is situated on top of the cylinder head. The atomiser consists of an automatic spring-loaded valve. The oil is driven past the valve and out through an annular opening between the valve cone and the jet plate in the form of a spray. On the top of each atomiser is a needle by-pass valve, which can be opened to allow the oil to return to a small collecting tank instead of being forced through the atomiser into the cylinder, thereby cutting out the cylinder in question. This by-pass is an important device, as it enables the functioning of each particular pump to be checked. The transmission gear includes a change-speed gear-box, which gives speeds of 4, 2·5 and 1·1 miles per hour in either direction, while the final drive is effected by means of a roller chain. The roller is equipped with power steering gear driven from the propeller shaft by means of a roller chain and chain wheel. The driving shaft carries two metal cone type clutches, and also bevel pinions; the latter are housed in a small gear-box. Attached to the bevel wheel shaft is a chain sprocket from which the steering worm and quadrant are driven. The drive is by means of a roller chain. The clutches are controlled by a lever placed in a convenient position to the left of the driver. By moving the lever left or right, the appropriate clutches are brought into engagement, and the front rolling wheel is turned in the desired direction. A safety gear is provided, which automatically cuts out the power steering if the rolling wheels are locked beyond a safe angle. The power steering gear is absolutely independent of the hand steering gear. The thrust on the clutches is taken by ball thrust washers and the bevel gears are enclosed and run in oil.

The 2½-ton roller illustrated by Fig. 4 is so well known that it scarcely requires description in these columns. Suffice to say it has a 13¼ B.H.P. engine, running on petrol, two speeds forward and reverse, and a rolling width of 4ft. It has a pressure per inch of width rolled, approximately the same as that of a 5-ton tandem roller. The machine is useful for rolling in chippings after emulsion spraying, and has the advantage that it is possible to roll close up to an obstruction or wall on both sides of the roller. This roller is claimed to be a 3 in 1 machine, because, by means of interchangeable back rolling wheels, it can be changed down to 1¾ tons in weight for light rolling, and a further change of rolling wheels gives it a rolling width of 6ft. for grass work.

Another exhibit by Barford and Perkins will be the "Victor" hand-guided roller, which weighs 12½ cwt., and is illustrated in Fig. 5. It is equipped with a water-cooled engine and quick reverse gear, and is suitable for work on footpaths, school playgrounds, private and public parks, tennis courts, bowling greens, &c. The two main driving wheels have a narrow space between them which accommodates a differential gear with consequent easy directional control. The wheel ahead and under the engine has a generous overlap of the space between the driving rollers.

The main rolling wheel diameters are each 36in. and the width 12½in., whilst the small rolling wheel is 16in. diameter by 9in. wide, with an overlap each side of 2in. The rolling width is 30in. All controls are within easy reach of the operator.

IMPERIAL CHEMICAL INDUSTRIES.

The exhibits of Imperial Chemical Industries, Millbank, London, S.W.1, will be most diverse and should appeal to many classes of engineers. Non-ferrous metals are to be shown in many forms, including thin strip as wide as 24in., produced by the new electrically driven mills which the company has recently put down. There will also be extruded sections, wire, and condenser tubes. In connection with the latter there is to be shown a modified and simpler form of the "Jet test" apparatus for testing the wearing qualities of tubes in actual operation.

Another section of this firm's exhibits will be devoted to plant for de-greasing metal parts by means of trichlorethylene, while one of especial interest to steam engineers will be that concerned with the preparation of boiler feed water. Five main types of waters will be exhibited, together with their description, analysis and photographs showing their origins, to be compared with specimens of the same waters to which the correct quantity of chemicals has been added to soften and condition them for industrial purposes. Alongside each treated specimen will be displayed the chemicals employed, in the correct proportions required for treating a given volume of water. The effects of using treated and untreated water for various purposes will be demonstrated by such exhibits as sections of corroded and burst boiler tubes, scaled economiser tubes, &c., compared with boiler tubes which have been running on treated water for a number of years and are still in good condition. There will also be samples of scale encountered in working with untreated water, *e.g.*, silicate, sulphate, and carbonate scales.

In connection with this matter of softening boiler feed water we have had some interesting conversations with one of the company's chemists, which may be summarised as follows.

The question of comparative costs of water softening and boiler cleaning can be discussed only in the most general terms, and favourable cost balances do not appear, as a rule, to give a truthful representation of the general considerations which should influence a decision to soften a water supply. Thus, the cost of a softening plant will depend mainly on its size, and in this connection it should be noted that in the case of waters containing large quantities of magnesia the rate of settling may be accelerated by the use of coagulants, such as sodium aluminate, and the size of the plant may be reduced to a corresponding degree.

The cost of reagents will depend entirely on the composition of the water. For instance, if the temporary hardness is high in relation to the permanent hardness then the softening will require hydrated lime mainly. On the other hand, if the permanent hardness due to lime is high, the principal reagent will be soda ash, or, in the case where a high permanent hardness is due to magnesia, soda ash, hydrated lime, and probably sodium aluminate will be required. There will be an increase in the cost of the treatment of these waters, in the order in which they are mentioned. In the majority of cases, however, the cost of softening reagents will not be more than a few pence per 1000 gallons. Frequently, the amount of soda ash present in the softened water will be sufficient to prevent the formation of hard adherent scale, but it is sometimes necessary to supplement this amount. The quantity of extra soda ash to be added will increase with the sulphate content of the water and the working pressure of the boiler, but in most cases the proportion of extra soda ash relative to the amount of softening reagents is small, and the increase in cost is only a small fraction of the total.

At boiler pressures above 250 lb. per square inch conditioning with soda ash is at present considered impracticable, and it is necessary to use sodium phosphate, which is more costly than soda ash. Such cases are not, however, frequent, as high-pressure boilers are generally worked with distilled make-up water.

When a softening plant is running steadily and a little experience has been obtained in doing the necessary tests for softening and boiler water analyses, the attention of one man for half a day is about all the labour that will be required.

With regard to the boilers themselves, their design plays an important part in the cost of conditioning. Boilers of the multi-tubular type are much more sensitive to changes in the composition of the water they are evaporating than those of the Lancashire type. In particular they are sensitive to the presence of particles of suspended matter, such as are frequently formed when untreated water, or waters conditioned by the addition of soda ash to the feed, are used. The suspended matter is very likely to give rise to priming and foaming troubles under certain conditions, and in order to reduce the amount of this material to a minimum it is clearly desirable to soften the feed and settle the precipitates outside the boiler. If the boiler is of the Lancashire type the need for external softening is not so great, and waters containing up to twelve parts of $CaCO_3$ per 100,000 (8 deg.–9 deg.) may be conditioned by the simple addition of soda ash without serious inconvenience through the precipitation of solid matter inside the boiler. It must be admitted that many waters of a much higher degree of hardness are being treated in this way and fed to both tubular and Lancashire boilers, but it is very doubtful whether the results can be accurately described as satisfactory in the majority of cases. The accumulated sludge often causes severe trouble which cannot always be mitigated by frequent blow downs.

The composition of the scales precipitated when untreated water is used as boiler feed varies considerably, but two general types may be distinguished:

(1) Soft scales, composed mainly of calcium carbonate and magnesium hydroxide.

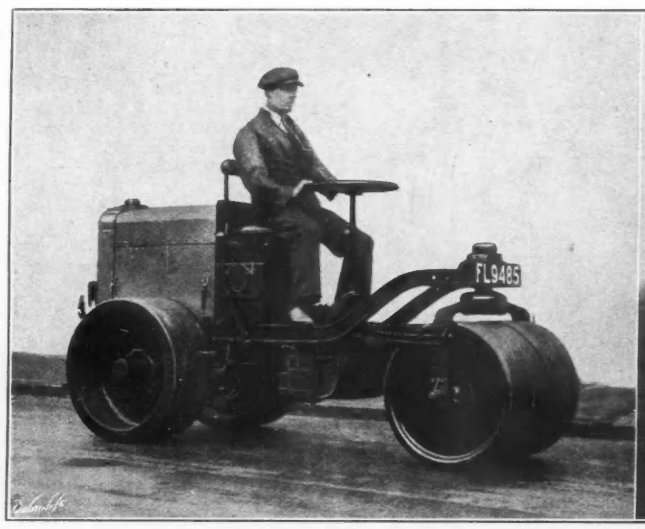


FIG. 4—PETROL-DRIVEN MOTOR ROLLER—BARFORD AND PERKINS

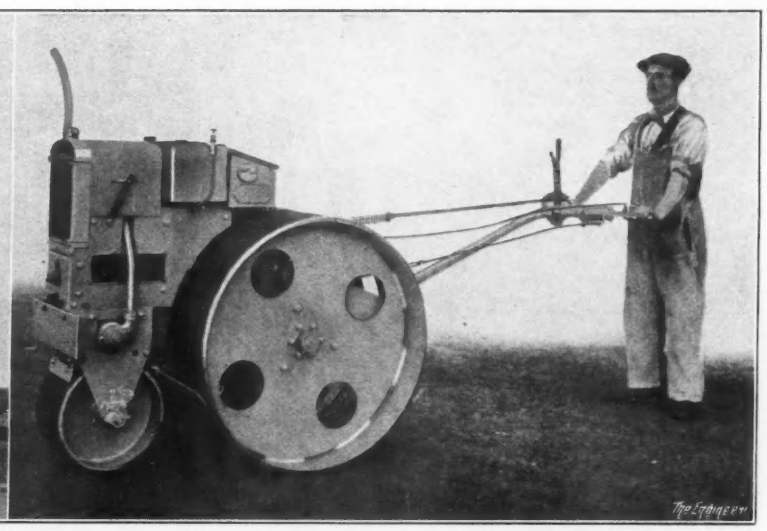


FIG. 5—HAND-GUIDED MOTOR ROLLER—BARFORD AND PERKINS

(2) Hard, adherent scales, composed mainly of calcium sulphate and calcium and magnesium silicates.

The former are comparatively easy and cheap to remove, but the latter are usually stubborn, and require special tools and a longer time. Furthermore, there are often odd corners from which it is impossible to remove hard scale except by the use of hand tools. This same hard scale is also a potential source of cost and danger by reason of the fact that its presence may lead to overheating, bulging, and rupture of the tubes.

It should be borne in mind that soft scales are usually formed from waters of high temporary hardness and low permanent hardness, and that such waters are cheap to soften since the principal reagent required is hydrated lime. On the other hand, the hard scales are usually formed from waters of high permanent hardness due to lime and require the more expensive reagent, soda ash. The consequences of using such waters untreated are, however, much more serious.

Finally, there arises the question of corrosion. Many untreated waters cause severe corrosion in economisers and boilers. This corrosion may be due to the action of soluble salts in the water, or to oxygen and carbon dioxide formed by the decomposition of bicarbonates. The removal of magnesia and bicarbonates by a preliminary softening process, which should also leave a small, but definite, caustic alkalinity in the softened feed water, will reduce corrosion to a minimum and sometimes eliminate it completely.

From the foregoing discussion it will be clear that although no natural water can be regarded as a satisfactory boiler feed without treatment, the cost of treatment varies according to the composition of the water. In many cases, the simple addition of soda ash is all that is required, in others a preliminary softening treatment is essential. The cost of such treatment is variable, but the benefits derived are

not confined to the saving of time and labour in cleaning and scraping, but are manifested by freedom from the dangers of explosion, from corrosion in economisers and boilers, and from the difficulties due to priming and foaming. In other words, the general performance and operation of the boiler are improved, the periods between cleaning may be increased, the actual time required for cleaning is reduced, and there will usually be a saving in fuel.

These considerations appear to justify the installation of a softening process in very many cases, but there are undoubtedly other cases where the cost of a continuous softening plant is unwarranted. In these circumstances the softening may often be carried out in two tanks, used alternately, so that the clear soft water from one is fed to the boiler, while the precipitates are settling in the other. This procedure is strongly recommended where the volume of water to be treated is comparatively small, say, 2000 gallons per day.

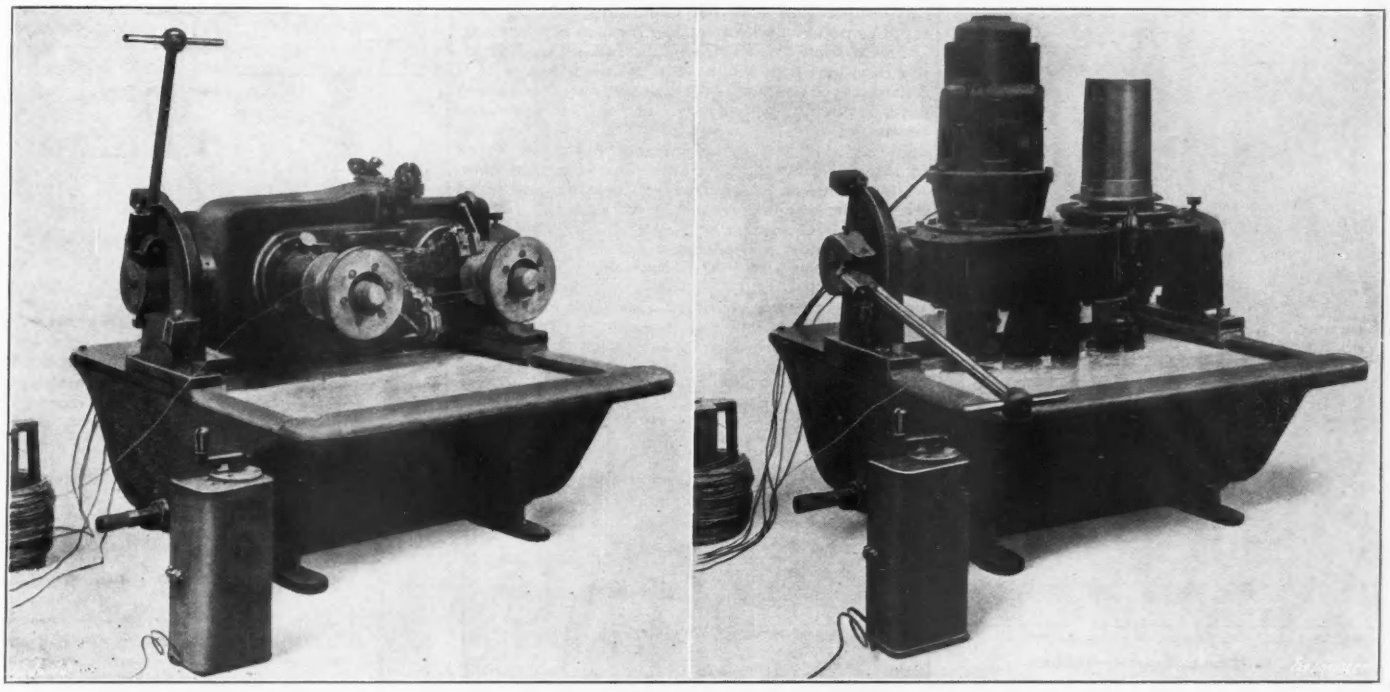
SIR JAMES FARMER, NORTON AND CO., LTD.

A new form of wire-drawing machine is to be shown by Sir James Farmer, Norton and Co., Ltd., of Adelphi Ironworks, Salford, Manchester, and two examples are illustrated in Figs. 6 to 9. These machines have been designed to take advantage of the high speeds possible when drawing wire through synthetic dies, where it becomes necessary to lubricate the wire and the dies most thoroughly. They are of the multiple pass type, in which the wire is drawn through the dies by means of stepped, or cone, pulleys, and are so devised that there are no idle cones, which are used on some machines for guiding purposes. The result is that the machines are unusually compact.

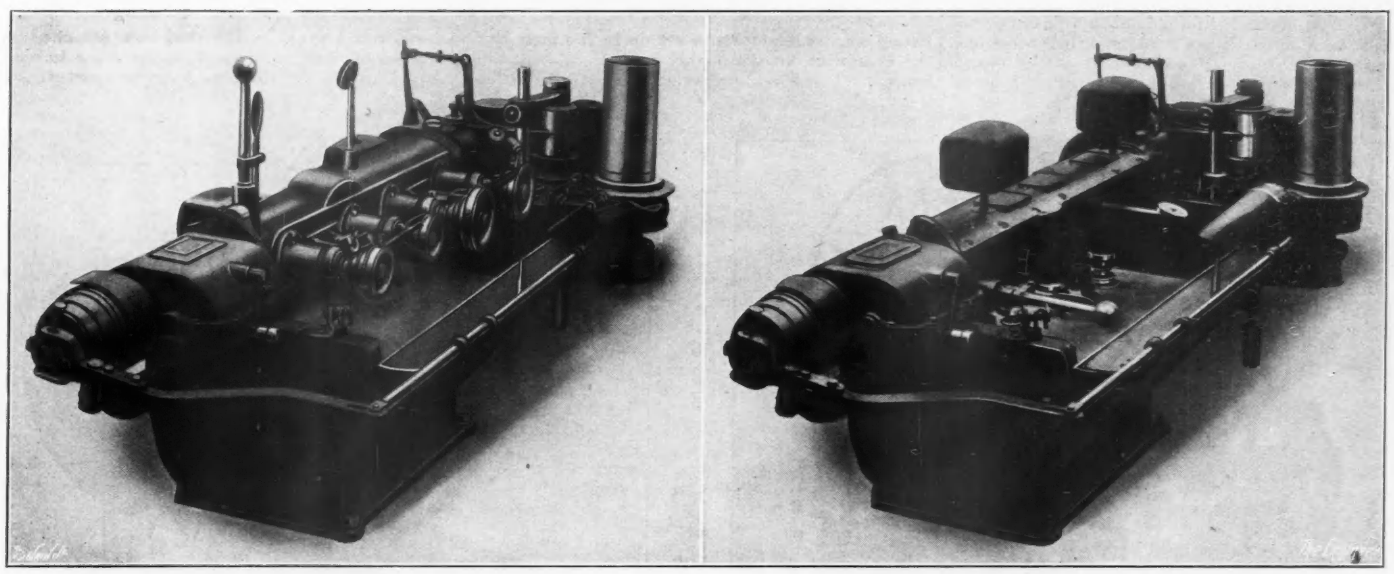
Instead of using pumps to supply the lubricant to the dies, the makers adopt the policy of completely immersing the dies and drawing cones in a bath of liquor. In this way all mechanical troubles associated with pumps are avoided, while the dies are most thoroughly cooled. It would obviously be most inconvenient to "string-up" the machine; that is to say, thread a new length of wire through the dies and round the cones when they were immersed in the liquor, so the whole mechanism is supported on horizontal trunnions, and can be swung through a right angle, to raise the cones out of the tank. In the horizontal position the dies are easily accessible, while when they are turned to the vertical position they are completely immersed. Our engravings show both machines in the alternative positions. It will be noticed that the larger diameters of the cones are arranged towards the ends of the spindles, so that the fast-running surfaces are well below the surface level, and there is a minimum tendency for the liquor to be stirred up into a turbulent overflowing froth. There is, nevertheless, sufficient movement to keep all the parts well cooled. In order to assist in this matter and to prevent the liquor being decomposed, water circulating coils are arranged in the bottom of the tank.

The machine illustrated in Figs. 6 and 7 is driven directly through a motor attached to the gear-box. The motor control gear, which is placed at the side of the machine, is arranged to give a slow speed for stringing-up purposes. The machine is equipped throughout with ball and roller bearings, all gears are cut from the solid, and where necessary are made of heat-treated steel. The gears run in oil in a totally enclosed gear-box. The drawing cones are made of heat-treated chromium nickel steel for copper drawing, and of a special hard alloy acid-resisting bronze for drawing steel wire. The machines for steel and copper are similar, except that different horse-power motors are required, according to the class of wire to be drawn, about 10 H.P. being required for steel and 30 H.P. for copper. For steel wire, the machines are fitted with acid-resisting bronze parts where they come into contact with the drawing liquor, and the liquor tank is lead lined.

The machine illustrated in Figs. 8 and 9 is of a duplex type, consisting of two nineteen-draft continuous wire-drawing machines, working entirely independently of one another. Each of these individual machines consists of a balanced gear-box carrying the drawing cones, which receive their drive from a belt pulley and friction clutch. Each machine is equipped throughout with ball and roller bearings, all gears are cut from the solid, and are made of nickel-chrome heat-treated steel. The gears run in oil in a totally enclosed box. Each machine is fitted with a reduction gear to enable stringing-up to be performed at an eighth of the running speed. The drawing cones are made of heat-treated chromium-nickel steel. This model is fitted with an arrangement so that the wire can be coiled on a winding-up block or reeled on spools. The reeling arrangement is such that the peripheral speed remains the same, whether the spool is full or empty. Therefore, the wire is reeled up at the same speed as it leaves the last die.



FIGS. 6 AND 7—TWO-CONE, HIGH-SPEED WIRE DRAWING MACHINE IN STRINGING-UP AND WORKING POSITIONS—FARMER, NORTON



FIGS. 8 AND 9—DUPLEX, HIGH-SPEED WIRE DRAWING MACHINE IN STRINGING-UP AND WORKING POSITIONS—FARMER, NORTON

THE BROOKE TOOL AND MANUFACTURING COMPANY, LTD.

Among the novelties on the stand of the Brooke Tool and Manufacturing Company, Ltd., Warwick-road, Greet, Birmingham, there will be the new drill chuck represented in Fig. 10, which is characterised by the fact that the jaws are positively located in

the casing, in the radial direction, by means of keys of the Woodruff type. These keys, which are plainly shown in the illustration, are made a press-fit in the hardened body and are held in place by soft soldering. The result is that the accuracy of the grip of the jaws is not materially affected by wear and tear. The actual construction of the chuck needs hardly any other reference, as it is so obvious

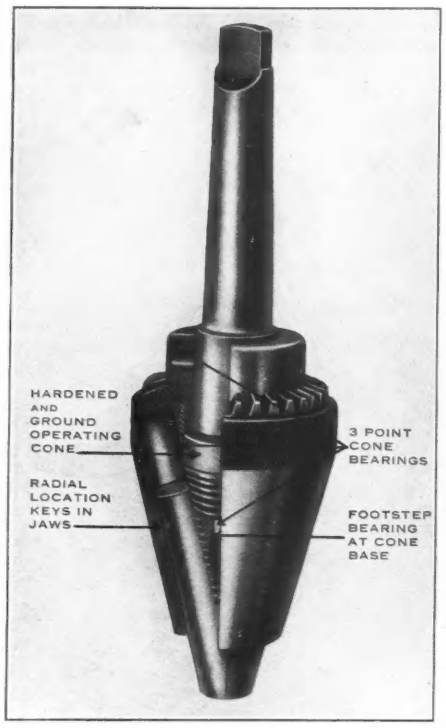


FIG. 10—DRILL CHUCK—BROOKE

from the drawing. This company will also be showing a number of other small machine tools, tapping attachments, machine vices, and so forth.

SHELL-MEX AND B.P., LTD.

At previous Fairs oil-burning equipment of various kinds has been exhibited on the Shell-Mex and B.P. stand. This year provides no exception. Indeed, the space engaged has been enlarged and the stand will contain much of interest to all those interested in oil-burning equipment, and might almost be termed an exhibition within an exhibition. Many firms will show their manufactures on the stand, and besides actual oil burners furnaces of various kinds for annealing, melting, &c., and a certain amount of automatic control gear of the thermostatic type will appear.

Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd.—This firm will exhibit an improved 3½-cwt. open-flame non-crucible type semi-rotary furnace similar to that shown on other occasions. Its neat design may be observed from the photograph reproduced in Fig. 11. Primarily designed for the melting of gun-metal, brass, and bronze, the furnace consists of a cylindrical body supported in a horizontal position and arranged to be capable of rotation about its axis. A burner is placed centrally at each end, and at intervals during the melting period the furnace is rolled over, so that the molten metal is brought into contact with that part of the lining which had previously been subjected to the full heat of the burners. In this manner the rapidity of melting is much accelerated. The most recent improvement made to this furnace is the fitting of a tapping valve—clearly to be seen in the engraving and shown in detail in Fig. 13. It is claimed for this manner of tapping that by its use the possibility of oxidation of the metal is much reduced, since, when the moulds or ingots are brought close to the nozzle the surface of metal exposed is almost negligible; that the necessity for shanking may be entirely eliminated; and that as the metal is drawn from the bottom of the bath the temperature can be maintained during the tapping period by keeping the burners in operation.

The Morgan Crucible Company, Ltd.—This Battersea (London) firm will have a melting furnace of a different type on show. It is illustrated by Fig. 12, and is tilted about a central axis. This exhibit represents the latest addition to the range of tilting furnaces made by the firm. Cylindrical steel plates reinforced by internal stiffening work form the melting chamber, while a cast iron ring bolted to the casing and fitted with a detachable centre plate forms the bottom support for the lining and crucible. Suitable heat insulating slabs and refractory bricks are used to line the furnace, while the cover, which is composed of sectional fire-bricks encased in a steel band fixed by clips to the furnace body, need only be removed when the crucible lining needs renewal. The melting metal is well protected from the products of combustion by the crucible and muffle ring, and since the zone of maximum temperature is disposed around the lower wall of the crucible it is claimed that the strong convection currents set up in the melt cause the charge to be thoroughly mixed and uniformly heated. A second engraving, Fig. 15, illustrates another furnace by the same makers similar in many respects to that already described. It is, however, of the lip axis type. A steel trunnion to which the pouring spout is attached is bolted horizontally to the front of the furnace. Normally, the furnace is supported in front by the trunnion and at the back by two pedestals bolted to the plate which forms the rim of the pit provided to catch any metal that may be spilt. Tilting is effected by a hand wheel, which is usually operated from a raised platform, and which sets in motion a worm gear turning sprocket wheels. These wheels are partly encircled by chains which are fastened at one end to steel arms attached to the bottom of the furnace and at the other to weights sufficiently heavy to balance the greater part of the load.

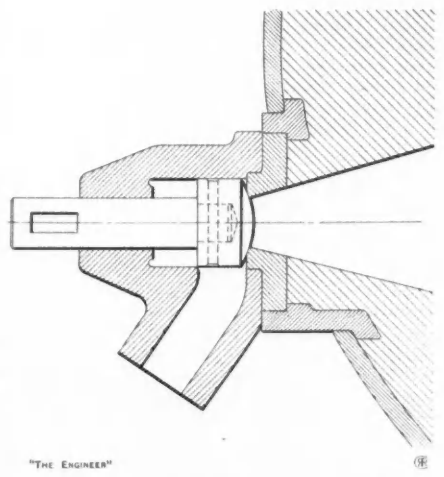


FIG. 13—POURING SPOUT—ARMSTRONG

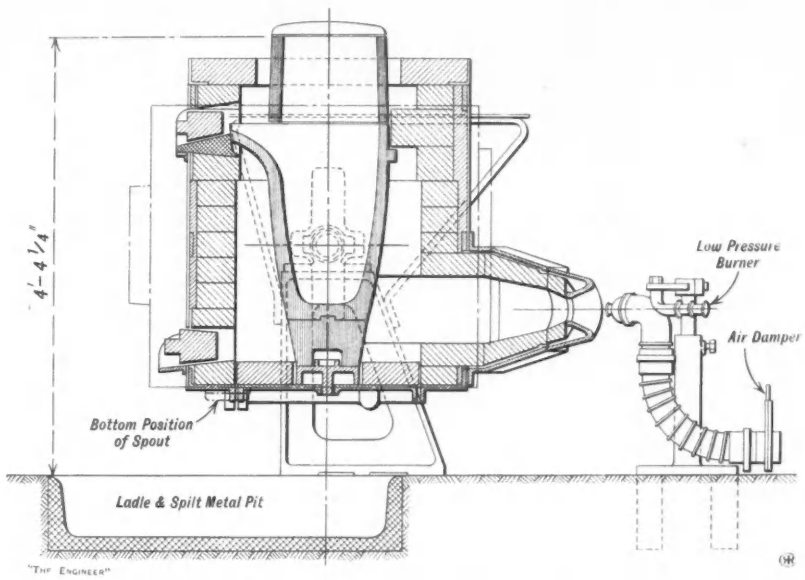


FIG. 12—OIL-FIRED TILTING METAL FURNACE—MORGAN

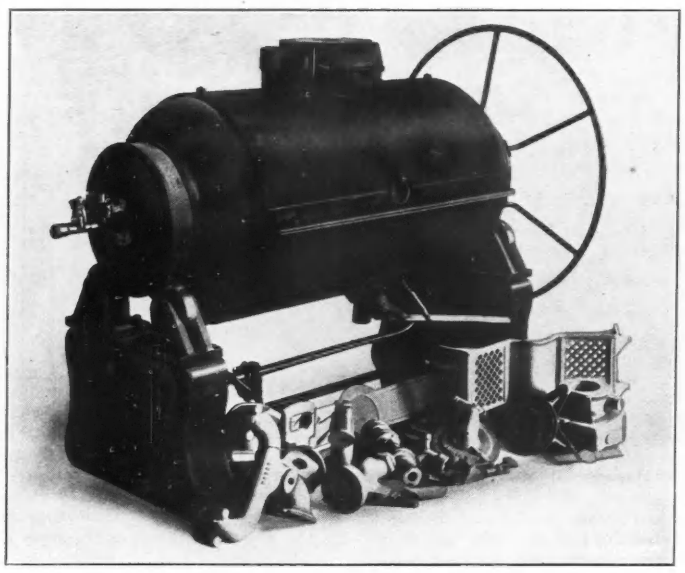


FIG. 11—3½-CWT. OIL-FIRED MELTING FURNACE—ARMSTRONG

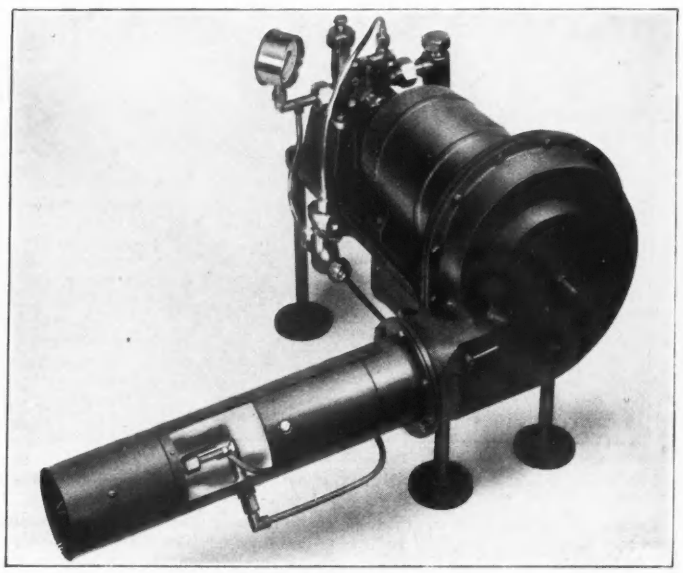


FIG. 14—AUTOMATIC FUEL OIL BURNER—LAIDLAW

Alldays and Onions, Ltd.—Space will not permit us to describe all the interesting furnaces to be exhibited on this stand, but that of the semi-muffle type shown by Alldays and Onions, Ltd., of Birmingham, deserves mention. It is suitable for heat treating steel at

temperatures up to 1400 deg. Cent., and has an effective heating space 24in. long, 18in. wide, and 12in. high. One of the firm's fan blast burners is employed as the heating medium and the combustion chamber is situated immediately beneath the heating chamber. The flames come up ports arranged in each side of the floor brick.

Laidlaw, Drew and Co., Ltd.—A fully automatic fuel oil burner made by this firm in its Edinburgh works is illustrated in Fig. 14. This device is particularly suitable for firing central heating and hot water boilers, but may also be used successfully for steam raising. It consists of a burner of the pressure jet type mounted in a draught tube and supplied with oil under pressure by a rotary fuel pump. The air for combustion is forced through the draught tube surrounding the burner and into the furnace by a small centrifugal fan. From the engraving the neat arrangement of the various parts may be seen. The rotary fuel pump is direct driven from one end of the motor, while the fan rotor is mounted on the other end of the shaft. An adjustable valve for controlling the oil pressure forms part of the pump body. The oil, issuing in a highly atomised condition from the jet, is ignited by an electric spark, the coil for the production of which is attached to the underside of the bed-plate. In addition to the parts already mentioned, there is an automatic oil shut-off valve and an air shutter. This little burner is controlled electrically by the device described in the next paragraph.

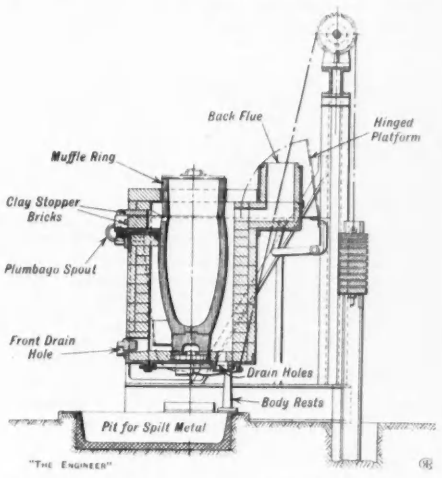


FIG. 15—LIP AXIS. OIL FIRED FURNACE—MORGAN

The Rheostatic Company, Ltd.—The engraving, Fig. 17, shows the control panel for an oil burner of the type just described, and made by the Rheostatic Company, Ltd., of Slough. It consists of two main operating parts, a heat motor switch and a main motor relay mounted in a pressed steel case. Correct sequence of switching is brought about by the heat motor which on the operation of a press button to start up the burner first switches on the ignition and then sets the burner motor in rotation. The controller is actuated by two thermostats situated respectively in the water of the boiler and in the flue. As soon as the burner flame is properly established, the flue thermostat is warmed by the gases and, operating the controller, cuts out the ignition. When the water in the boiler has reached any predetermined temperature the thermostat placed within it, acting through a small relay current, breaks the main electrical circuit and shuts down the burner motor. As the motor slows down and the oil pressure begins to fall, the oil shut-off valve closes and extinguishes the flame, while as the fan stops the air shutters close, thus preventing entry of cold air to the furnace. The whole set remains idle until through the fall of the water temperature by two or three degrees, the thermostat once more closes the switches and the burner automatically lights up as before. Accidents are prevented by the thermostat in the flue acting upon the controller. There is a thermal delay strip on the control panel which allows the burner a predetermined period in which to light. If it does so, the heating of the flue thermostat causes the ignition to be shut off, but if the attempt is a failure, not only is the ignition shut off but the whole set is shut down and "locked out." A notice to this effect appears in a window of the controller and the plant cannot be restarted until a knob has been reset manually. Extinction of the flame for any reason, of course, cools the flue thermostat, with the result that an attempt to restart is automatically made. If it fails, the set "locks out." Even should the thermostat fail to operate, little harm can be done, for if it jams in the "cold" position, the controller must inevitably "lock out," while if it remains fixed in the "hot" position the ignition is permanently "cut out."

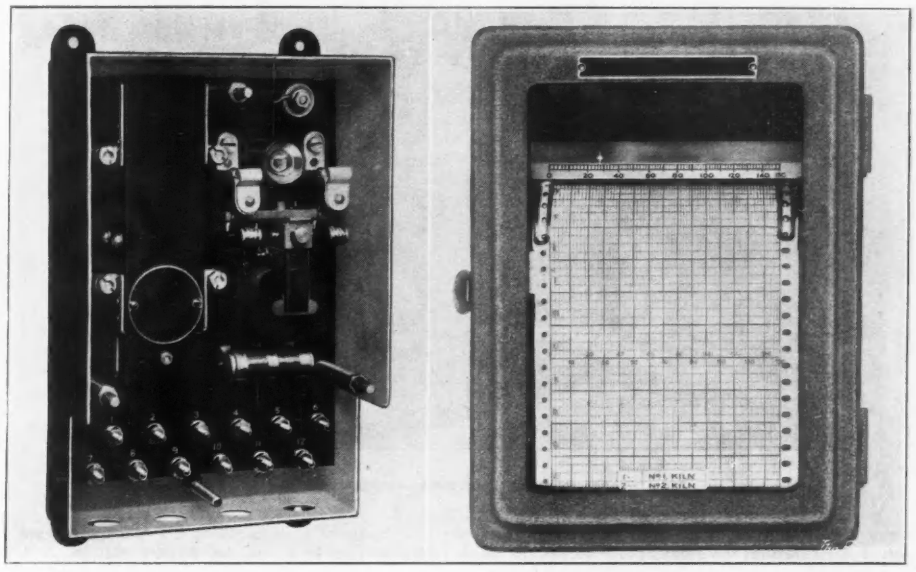


FIG. 17—CONTROL PANEL—RHEOSTATIC

FIG. 18—RECORDING PYROMETER—ELECTROFLO

Parker, Winder and Achurch, Ltd.—This Birmingham firm will exhibit on the Shell-Mex stand an oil burner of a type similar to that just described, and a number of others demonstrating the complete range of such equipment will be shown on its own stand. The accompanying engraving—Fig. 19—gives an excellent idea of the appearance of one of the smaller of these oil-burning units, which are made in a range of sizes suitable for boiler duties of 76,000 to 2,000,000 B.Th.U. per hour. It will be seen from the engraving that the oil pump is mounted at one end of the motor shaft, which carries at its other end the rotor of a Sirocco fan for supplying the necessary air. The nozzle of the burner is manufactured with a considerable number of variations, so that the burner which will give the correct shape of flame to suit any combustion space may be chosen. It is claimed that the flame produced is so soft and floating that the set is very silent in operation. Control of the burner is effected by thermostats, and an electric control panel similar to that just described, made by the Rheostatic Company, Ltd.

G. C. Pillinger and Co., Ltd.—An "Electromatic" oil burner, working on the pressure jet principle, will be exhibited by G. C. Pillinger and Co., Ltd., of Birmingham. The oil is completely atomised by pressure only, and the correct amount of air is added by means of a low-pressure air system controlled by adjustable shutters on the inlet side. On entering the combustion chamber the supplies of oil and air are so arranged that they are swirling in opposite directions, so that, it is claimed, the atomised oil spray is held completely in suspension by an outer layer of rotating air. Thermostats in the flue are not used in conjunction with this burner, a suitable control being arranged on the burner itself. The burner is made in three sizes, suitable for boiler ratings of 300,000, 800,000, and 3,000,000 B.Th.U. per hour.

Combustions, Ltd.—Yet another burner will be shown by Combustions, Ltd., of Walbrook, London. It is known as the "Rotamisor," and will be fitted to a triple-cased enamelling oven manufactured by Messrs. Silas Hyde, of Birmingham. The equipment includes a low-pressure air centrifugal fan and an air compressor, in order to demonstrate that the burner is capable of working efficiently with air pressures as low as 8in. water gauge or as high as 100 lb. per square inch. Thermostats placed in the stove control the air and oil-regulating valves, so that a practically constant temperature is maintained.

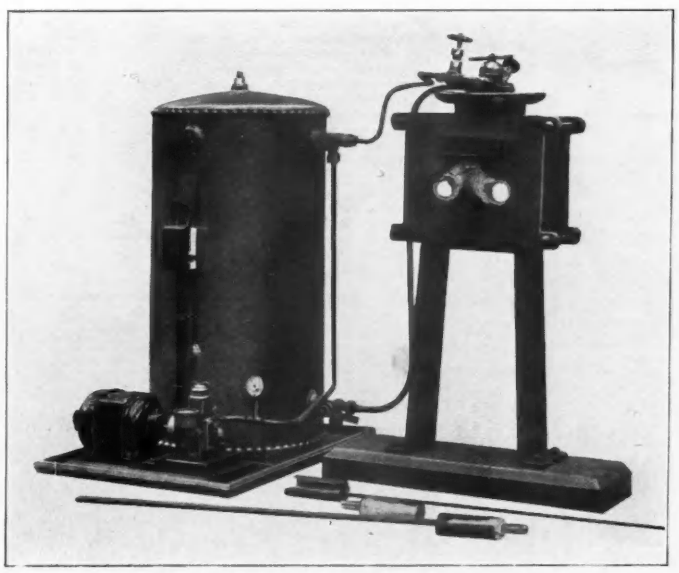


FIG. 16—BOTTLE RE-HEATING FURNACE—SWINNEY

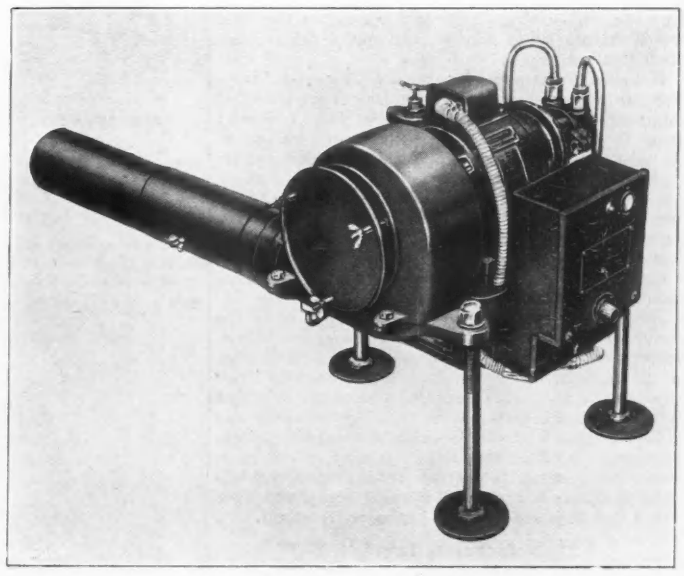


FIG. 19—AUTOMATIC OIL BURNER—PARKER

Electroflo Meters, Ltd.—Besides actual oil-firing equipment and oil-fired furnaces, pyrometers of various types will be shown on the stand. An electrical pyrometer of the recording type, made by Electroflo Meters, Ltd., of London, N.W.10, is illustrated in Fig. 18. This instrument has a current sensitivity such that a change of 0·43 micro-ampères causes a movement of 1 mm. and its average resistance is

18 ohms per millivolt. It employs the 6in. wide, 1600-hour, straight-line chart, and the glass door exposes the full record made during the last nine hours. When two records—from two different furnaces, for instance—are made simultaneously on the same chart, they are distinguished by different markings.

Swinney Brothers, Ltd.—Reverting again to furnaces, there is illustrated in Fig. 16 one for reheating bottle necks for final finishing. It will be exhibited by

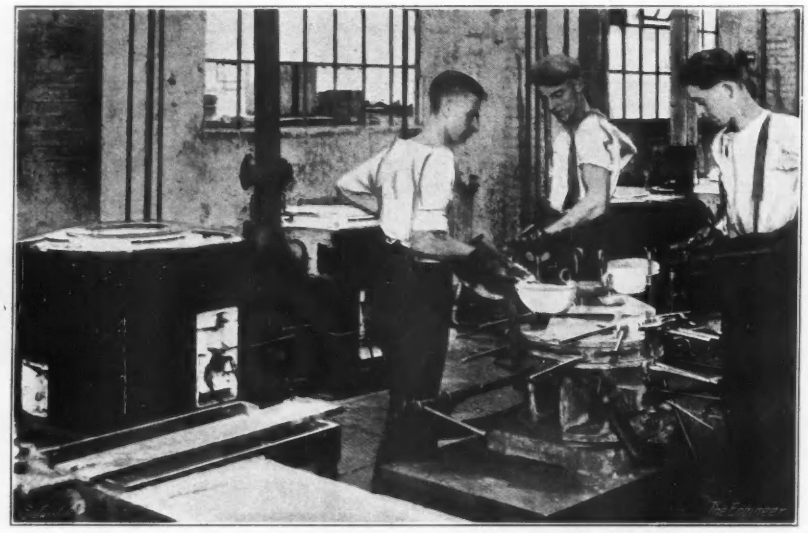


FIG. 20—ALUMINIUM MELTING FURNACE—URQUHARTS

Swinney Brothers, Ltd., of Morpeth. The furnace itself is to be seen on the right of the engraving, while the tank on the left contains the fuel oil. A motor-driven positive rotary air blower set is mounted alongside the fuel tank upon the side of which the starter is situated. According to the dimensions given by the makers, the unit occupies only 6 square feet of floor space, and uses less than one-third of a gallon of oil per hour.

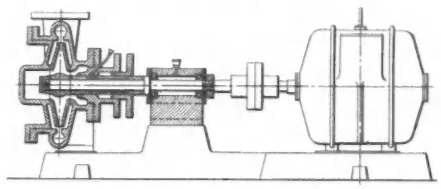
Urquharts (1926), *Ltd.*—An oil-fired furnace having a capacity of 3 cwt. of aluminium will be exhibited by Urquharts (1926), Ltd., of Kingsway, London. It is constructed according to accepted modern practice for this type of furnace, and either a cast iron or a Salamander pot may be fitted. Firing is effected by a medium air pressure oil burner, which is claimed to be particularly flexible in operation, and capable of adjustment between full load and one-tenth of full load. The makers state that figures obtained from twelve similar furnaces installed in an aluminium foundry indicate that the cost of fuel is 0·171d. per pound of castings made. The accompanying engraving—Fig. 20—shows a pair of furnaces on the left and a casting being poured with metal taken from them on the right.

Wallsend Slipway and Engineering Company, Ltd.—Low air pressure burners consuming from ½ to 200 gallons of oil per hour will be exhibited by this Wallsend firm. It is stated that although they work with a low air pressure, only a surprisingly small quantity of air is required for the atomisation of the oil in these burners, and the claim is consequently made that they may be applied successfully to reverberatory and regenerative furnaces. One of the smallest of these burners is to be shown as a working exhibit applied to a furnace somewhat of the shape and dimensions encountered in a baker's oven.

Space, unfortunately, does not permit us to describe or even to mention all the interesting and instructive exhibits on this stand, and a mere list of the names of the firms which have availed themselves of the opportunity to show their products, while it might indicate to the initiated some idea of what there was to be seen, would be in the main no superior to the catalogue issued at the Fair. In fact, there is so much that is certain to attract those engineers interested in furnaces and in oil-burning equipment that only a visit to it can really do justice to the stand.

MELDRUMS LTD.

The firm of Meldrums Ltd., of Timperley, is, perhaps, best known for its stokers, and as is to be expected in the circumstances, the most important item on the stand is a sprinkler mechanical stoker attached to one side of a Lancashire boiler. A set of moving bars and a hand-rocking grate are also to be seen. The firm is, however, by no means concerned only with grates, stokers, and furnaces, as the accompanying line drawing—Fig. 21—will indicate. This centrifugal pump is made of Meldrum acid-resisting metal, Regulus metal, acid-resisting bronze, or stainless steel, according to the acid with which it will be used. It is, of course, intended for use with chemical plant. As will be seen from the engraving, the pump is of the double-suction type, which has the important advantage, where acids are concerned, that the gland is under suction pressure and that, therefore, the possibility of injurious leakage is avoided. The steel shaft is protected where it passes through the gland by a sleeve of suitable acid-resisting material, and is supported between the pump and driving motor by two ball bearings set far apart. Easy access to the interior of the pump casing for examination or renewal of the impeller is obtained by the removal of the end cover, and this work does not involve breaking the joints of the pipe lines. The whole unit is mounted on a cast iron bed-plate, and is made in a range of sizes suitable for pumping from 1000 gallons per hour up to 40,000 gallons per hour. Besides the exhibits already mentioned, the firm will show a smoke-door for eliminating smoke on



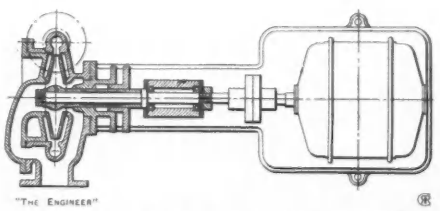


FIG. 21—ACID-RESISTING PUMP—MELDRUM

vertical and locomotive type boilers; a model refuse destructor, and sack portable disinfectors.

ALFRED HERBERT, LTD.

From an early date the firm of Alfred Herbert, Ltd., took an interest in pulverised fuel firing, and the Atritor is one of the best-known pulverising devices. Not content merely to show the device alone, the firm almost invariably adds to the interest by installing it in operation, firing some kind of furnace in order to demonstrate its capabilities. At this year's Fair a forge furnace for billets has been chosen, and in the accompanying engraving, Fig. 22, the arrangement of the pulveriser unit and its pipework in relation to the heating chamber may be observed. The makers claim that substantial savings in the cost of fuel can be made by adopting this form of firing, and give in support of this claim the following figures obtained by converting a hand-fired copper smelting furnace to mechanical firing:—

	Hand-fired.	Atritor-fired.
Weight of copper smelted per week, tons	70	100
Weight of coal burned per week, tons	23	14
Price of coal, per ton	20s.	11s.
Weight of fuel per ton of copper, cwt.	6·57	2·8
Cost of fuel per ton of copper	£23	£7 19s.
Increase of production, per cent.	—	23

Another interesting exhibit will show a recent development in the use of the Atritor unit. A Lancashire boiler front is mounted on the stand and an Atritor is placed in the firing position and connected to the burners. This development has been made possible

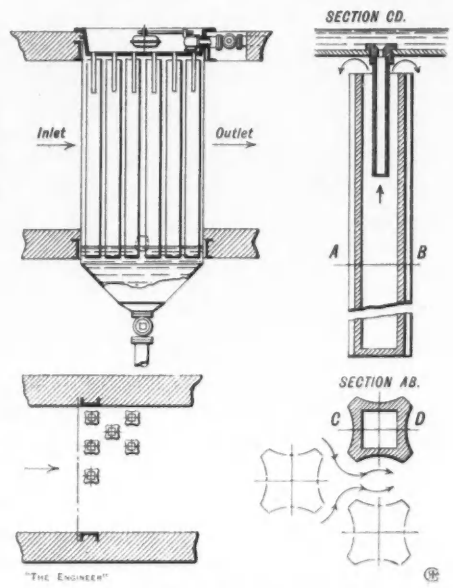


FIG. 23—FLUE GAS CLEANER—HERBERT

by the adoption of burners of the rotating type, delivering a short flame. By the courtesy of the firm we are able to publish the following figures obtained from an eight-hour test recently made on two Lancashire boilers fitted with Atritor pulverisers. Each boiler was 8ft. 6in. in diameter by 30ft. long. Neither had an economiser, but one was fitted with a superheater.

Period of test, hours	8
Steam pressures, lb. per square inch absolute	166
Temperature of feed water, deg. Fah.	187·2
Temperature of superheated steam, deg. Fah.	495·3
Temperature of saturated steam, deg. Fah.	366·5
CO_2 content in flue gases, per cent.	11·2
Total water evaporated per hour	130·368 lb.
Water evaporated per hour	16·296 lb.
Total coal burned	13·227 lb.
Coal burned per hour	1,653·3 lb.
Coal analysis—	
Moisture, per cent.	1·6
Fixed carbon, per cent.	53·9
Volatiles, per cent.	28·4
Ash, per cent.	16·1
Calorific value as fired	12,940 B.Th.U. per lb.
Summary—	
Actual evaporation per lb. of coal	9·855 lb.
Evaporation from and at 212 deg. Fah.	10·939 lb.
Factor of evaporation	1·11
Efficiency, per cent.	81·8

The modern demand for smoke abatement and the prevention of the emission of grit and noxious fumes from chimney stacks has caused various gas-washing appliances to be placed on the market. A model will be exhibited on this stand of the Hanrez-Modave patent dust arrester and desulphuriser, which is

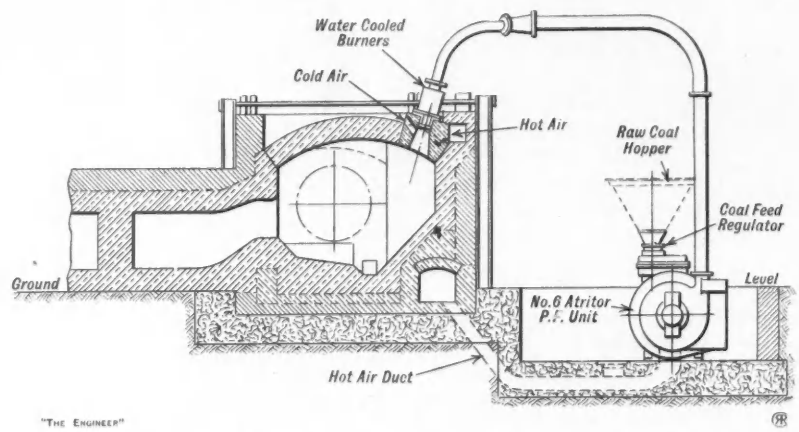


FIG. 22—BILLET FURNACE HEATED BY PULVERISED COAL—HERBERT

now made in this country by Impic, Ltd., of 36, Victoria-street, for which Alfred Herbert, Ltd., act as sole selling agents. The description which follows will be made clearer by observation of the engraving, Fig. 23.

This dust arrester collects the fine dust which escapes from the combustion chamber with the flue gases. This dust usually passes straight to the atmosphere, and in large installations using pulverised fuel is a source of considerable trouble. It is claimed that the Hanrez-Modave dust arrester is capable of extracting 90 per cent. of the dust, and that it can also be arranged to extract up to 90 per cent. of the sulphur oxides contained in the flue gases. Water flows through the orifices in the upper tank into the hollow elements, fills each element, overflows and runs down all four sides into the bottom tank. The gases enter the apparatus at right angles to the axes of the elements. In the passage of the gases through the nest of elements, the dust particles come into contact with the wet surfaces, and, sticking there, are washed down into the bottom tank, whence they are carried away by the water which passes out of the apparatus by the valve at the bottom. This valve is adjusted so that a trickle of water is always issuing from the overflow, showing that the level in the bottom tank is correct. The elements must dip into the water to prevent the gases short-circuiting past them. The water charged with dust is run either to waste or to settling ponds, where the dust is precipitated. In the latter case the clean water may be recirculated through the apparatus. In addition to the cleaning of flue gases the Hanrez-Modave arrester may be used to collect the fine particles of dust caused in various manufacturing operations. For instance, it is used in sugar refineries. By passing the dust-laden air through the arrester the major portion of the sugar dust is collected for commercial use, and the atmosphere in the works is kept fresh and clean.

BELLISS AND MORCOM, LTD.

On the stand of Belliss and Morcom, Ltd., of Ledsam-street Works, Birmingham, there will be displayed a wide range of the firm's products which will include a typical steam turbine unit, a steam engine, and an air compressor, all of which have been specially prepared so as to admit of the inspection of their principal working parts. In a compressed gas filling station outside the main Fair buildings there will be exhibited a 5000 lb. per square inch high-pressure gas compressor for charging cylinders. We shall refer more particularly to this exhibit later on in our article.

We have chosen for more detailed description a new type of oil engine which has recently been developed by the oil engine department of the firm. It will be shown by two units, a six-cylinder, 200 B.H.P. engine, coupled to a direct-current generator.

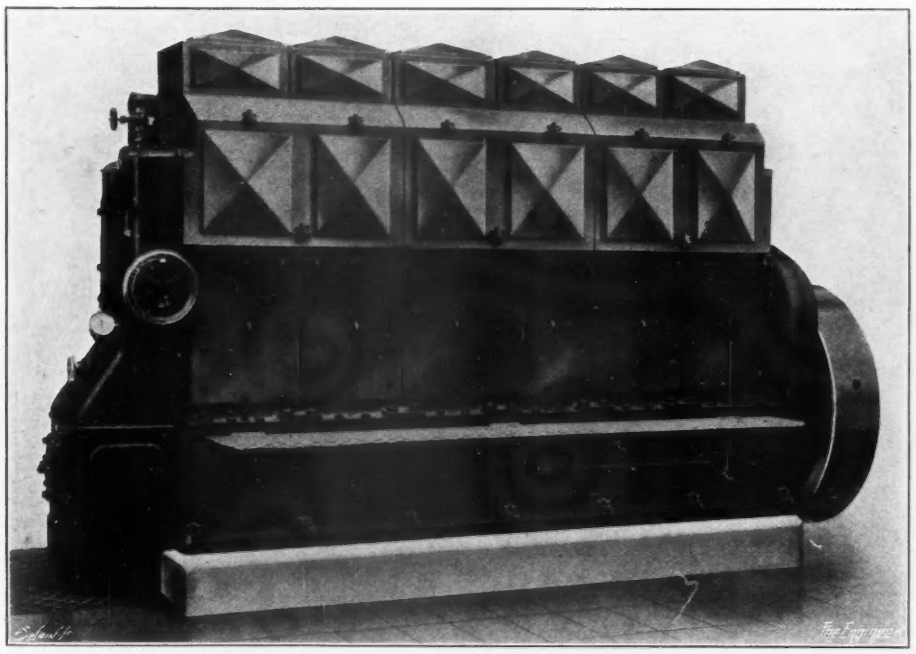


FIG. 24—200 B.H.P. SIX-CYLINDER OIL ENGINE—BELLISS

and a similar 100 B.H.P., three-cylinder engine, which will have the principal inspection doors removed so that the internal running parts and valve gear can be inspected. These engines are illustrated in Figs. 24 and 26, and in Fig. 25 we reproduce a section through the smaller engine. It has a cylinder bore of 8½in., with a stroke of 12½in., and is designed to develop 33⅓ B.H.P. per cylinder at a speed of 600 r.p.m. It operates on the single-acting, four-stroke principle, with airless injection. As will be clear from our illustration, the bed-plate is substantially proportioned and to it is bolted the crank case casting, which is of the mono block pattern. The stresses are transmitted to the bed-plate by means of a ribbed arch construction, and the bed-plate is also suitably reinforced by internal ribbing. At the front of the bed-plate a light service platform is carried. The bed-plate is designed to collect the lubricating oil on the dry sump principle, the oil being drained at the governor end of the engine to the tank in which both the lubricating pump and the oil strainer are placed. The crank shaft and the connecting-rods are machined from mild open-hearth steel forgings. For the liners, pistons, and cylinder heads, a special Perlit cast iron is employed. The liners are bored to within a few thousandths of the finished dimension, and are then finished by honing. All the water spaces around the liners and valve casings in the cylinder heads are so designed that access for cleaning is given by conveniently positioned inspection doors. As our drawing, Fig. 25, indicates, the pistons have dished crowns and carry three upper rings and a lower scraper ring. The gudgeon pins are of the restricted floating pattern, and are hardened to a glass hard finish and finally ground. Large bearing surfaces are provided.

The cam shaft is carried within the monobloc cylinder and crank casing and the large removable inspection doors—see Fig. 26—give easy access to the crank shaft bearings and the running parts and the cam shaft and fuel pump gear. As will be seen from Fig. 24, doors and covers of a pyramidal panel form are used to enclose both the fuel pumps and top valve gear. The drawing reproduced in Fig. 25 clearly shows the construction of the air inlet, exhaust, and fuel valves. The whole of the valve-operating gear is lubricated from the main system. The fuel pumps are of the Belliss-Bosch type, and they are housed in a separate compartment of the engine casing with independent drain arrangements, so that any fuel oil which may escape will not contaminate the lubricating oil in the crank case. Fuel pump priming and adjusting gear is fitted to each pump. The cam shaft is driven by spur gearing from the crank shaft, and a feature of the gear wheels is their special steel rim and light construction. The cam shaft is lubricated from the main pressure system and the cam shaft gear also benefits from a system of vapour lubrication. The air for the engine is drawn in through the filter doors at the back of the engine, and this passage is connected to the cylinder head vents which are arranged to draw vapour from the crank case, *viâ* the push-rod passages. A centrifugal type of governor is used, which has been designed to give a permanent speed variation of 3½ to 4 per cent., and a maximum variation of 7 to 10 per cent., when

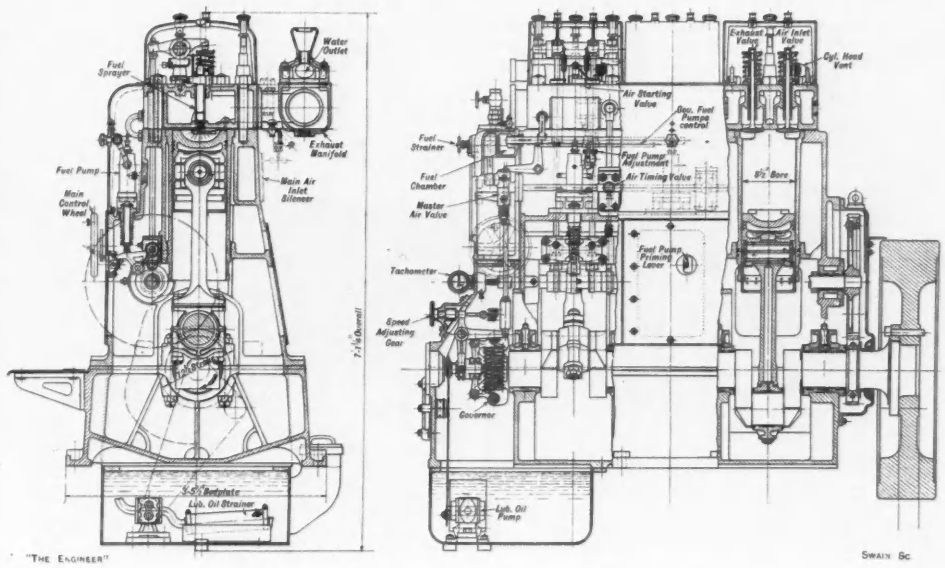


FIG. 25—SECTIONS THROUGH OIL ENGINE—BELLISS

the load is suddenly thrown off the engine. A feature of the engine control arrangement is the simplicity of the interlocked starting gear, which, by means of the single main control wheel, operates in the correct sequence both the starting air control valves and the fuel pumps. There are four notched positions marked on the hand wheel, which, it is claimed, enable the consecutive operations to be carried out easily and without mistake. A feature of the control gear is the provision whereby when the engine is being run on compressed air no fuel can be admitted to the cylinders. In changing over from air to fuel, the supply of starting air is entirely cut off from the cylinder and the amount of fuel which is then admitted in the initial stages of combustion is a regulated quantity, so that excessive pressures within the cylinder are prevented. Only when the

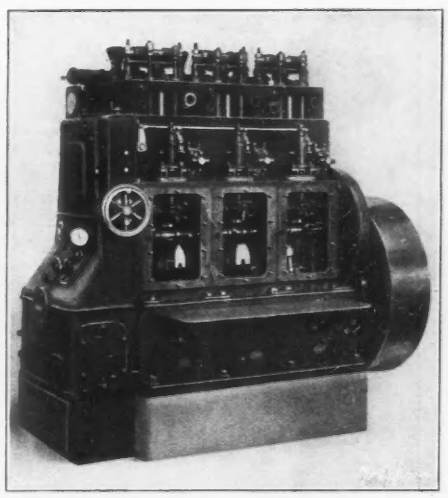


FIG. 26—100 H.P. OIL ENGINE—BELLISS

engine has run up to speed does the governor take control, but on both the starting and stop positions the fuel pumps are not governor controlled. The control system has been designed to avoid the delivery of an undesirable amount of fuel to the cylinders at slow speeds. As will be seen from our illustrations, the control gear is neatly arranged at the end of the engine opposite the fly-wheel, and at the same end is also a tachometer giving engine speed. Immediately below the tachometer is the speed-adjusting gear. The lubricating oil pump is equipped with a free-wheel gear, so that after standing the oil pump can be hand operated to flush the lubricating system before starting up. The oil gauge is let in level with the end cover near to the tachometer, and in operation the oil pressure is automatically regulated, the gauge being fitted with a safety stop so that when starting from cold it cannot be damaged by excessive pressure.

As previously mentioned, Belliss and Morcom, Ltd., will also show in the gas charging station a steam-driven two-crank, four-stage compressor, specially designed for the purpose of compressing coal gas up to 5000 lb. per square inch. The plant, which was described in detail in THE ENGINEER of December 23rd last, works in conjunction with a separator column and storage cylinders, which are furnished with automatic control and relief valves for gas pressures of 5000 lb., 3000 lb., and 1850 lb. per square inch. The plant will operate in conjunction with gas-propelled vehicles, which will be demonstrated at the Fair.

ROBERT HUDSON, LTD.

Among the larger exhibits arranged by Robert Hudson, Ltd., of 38a, Bond-street, Leeds, and Gildersome Foundry, near Leeds, will be the 15-ton capacity double-side automatic tipping wagons, which we illustrate in Fig. 27. They were designed for the standard 4ft. 8½in. gauge, and will transport 300 cubic feet of limestone, chalk, slag, or other material. The body, which is made of mild steel side and end plates with a solid pressed steel bottom, is reinforced by steel sections. It can be made of different strengths in order to meet varying conditions of loading. The tipping trunnions are of cast steel and there are two catches which hold the body upright in normal running position, but when released they allow the wagon to dump its load and automatically to return to the tongues which give the necessary rise, it is claimed, without a jar and without increased effort. There are two models and they are constructed in different lengths and radii and for various gauges. Fig. 30 illustrates a new type of concrete pouring skip constructed under McGivern's patent, which, it is claimed, enables concrete to be either quickly or gradually discharged as may be desired without the possibility of accidental discharge. As our drawing clearly shows, the skip is of circular form with a conical lower end, which is furnished with a ball valve lifted by a rod. The skip is one which, it will be seen, can be quite easily positioned and it does not require tilting, thereby avoiding possible damage to forms and shuttering. There are no springs or catches and the skip and the ball operating lever can quite well be handled on cable by a derrick or hoist. The skips we have described are manufactured in four sizes from a half up to two cubic yards, increasing by a half cubic yard. The internal diameter of the smaller skip is 3ft., and that of the largest 5ft., and the outlet diameter of the small half-yard skip is 8½in., while that of the other three skips is 11½in.

FIG. 27—15-TON DOUBLE SIDE TIPPING WAGONS—HUDSON

CHARLES WINN AND CO., LTD.

The firm of Charles Winn and Co., Ltd., of Birmingham, has, as it were, two sides to its business. To the general engineer the range of screwing, cutting-off, and tapping machines and allied tools will provide the greatest appeal, while the sanitary engineer will find much to interest him in valves and fittings, ablution fountains, drinking fountains, &c., to which this year the firm has devoted rather more space than usual. A fairly recent development on the sanitary side is the complete range of filling and emptying valves for public baths produced by the firm. On the general engineering side the tube-works screwing and cutting-off machine illustrated by the half-tone engravings Figs. 28 and 29 will arouse interest as a very neat design. It is built in a wide range of sizes and particular care has been taken to make it sturdy enough to withstand the constant heavy demands of a modern tube works. A glance at the engraving is enough to show that its proportions conform to modern practice in the design of such machines. The smaller sizes have an ordinary leg stand, intermediate sizes leg and cabinet, and in the largest frame and stand are cast in one piece and there is a cabinet for the storage of tools at the headstock end. Power is obtained by belt from overhead or other shafting and is transmitted through heavy gearing. The spindle has a clear bore right through and will pass sockets of the maximum size of tube screwed by the machine. Thus all tubes may be socketed under power before removal from the machine. A simply constructed self-centring quick-grip chuck is fitted, while a steady chuck is fitted to all but the smallest sizes, which have instead a steady bush holder. The larger sizes of machine have also a lead screw. Cam-controlled dies are used in the die head. They are of the adjustable chaser type. Mounted on the saddle or on the die head, according to the size of the machine, there is a cutting-off slide, while self-centring steadies with hardened steel faces are placed directly behind the die head to steady the tube as it is cut off. A special frazing tool can be used for removing the burr from the inside of the tube after cutting off. This tool may be swung into and out of position by means of the horizontal lever at the back of the die head, as seen in the engravings. One of the interesting features of the machine is that a special nipple-making slide can be fitted in position instead of the ordinary cutting-off slide. This nipple-making slide consists of a cutting-off rest with front and back tool posts carried on an auxiliary slide which is free to travel independently of the saddle. The nipples may thus be cut off as fast as the tube screws through the dies, while an adjustable stop determines the length.

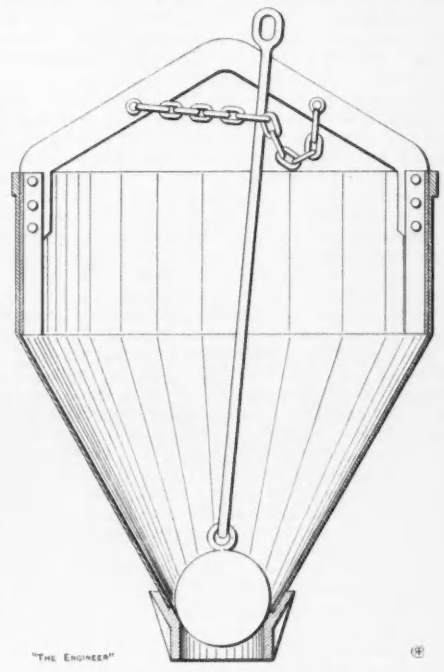
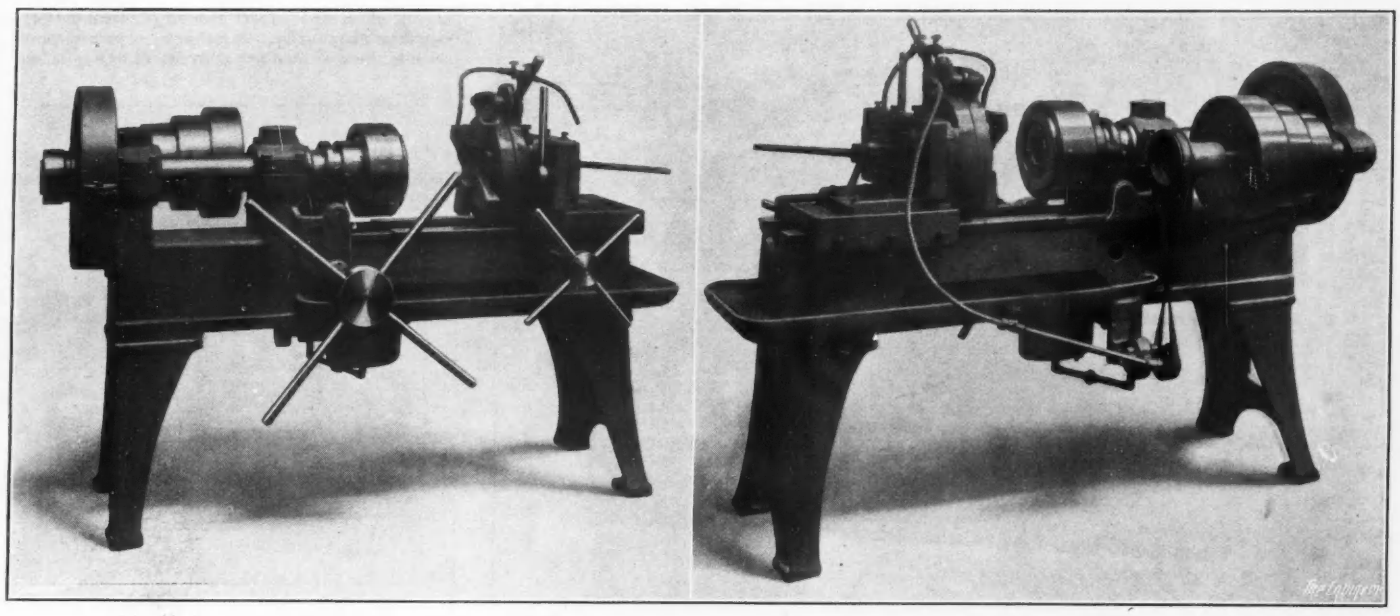


FIG. 30—CONCRETE SKIP—HUDSON



FIGS. 28 AND 29—BACK AND FRONT VIEWS OF SCREWING AND CUTTING-OFF MACHINE—WINN

A Seven-Day Journal

B.E.A.M.A. Research Association.

DURING the course of his presidential address, delivered at the annual luncheon of the British Electrical and Allied Industries Research Association on Wednesday, February 15th, Mr. R. P. Sloan said that a number of supply authorities still failed to give the Association support. There were many prosperous supply undertakings whose subscriptions were less than one-third of the "scale" figure and some which contributed nothing at all. It might surprise many to learn that the Association received from supply authorities only 50 per cent. of the amount it would get if they all adopted the "scale" basis, which was equivalent to only £1 for each £2500 of annual revenue from the sale of electrical energy, excluding bulk supplies. He did not like to think there were people who stood-by knowing they would reap benefits of the work done by the Association without contributing towards its funds, or contributing only a fraction of what might reasonably be expected. There had been and still was a tendency for some authorities to withhold support from certain objects unless they were convinced that individually they would gain some definitely ascertainable benefit. That attitude was evidenced by the feeble support such authorities gave to active organisations like the Electrical Development Association. National publicity did not appeal to them. They had no interest in popularising the use of electricity generally. What they wanted was to popularise it in their own particular areas and what happened outside was no concern of theirs. Such an attitude might have been described in the past as merely a narrow view, but the advent of the national scheme had entirely altered the position. Anything which helped to reduce the cost of production, transmission, or distribution or to popularise the use of electricity in any quarter would help to increase sales, which was vitally important to the ultimate success of the scheme.

The New Cunarder.

SPEAKING in the House of Commons on Thursday of last week, February 16th, in the unemployment debate, Mr. Neville Chamberlain, the Chancellor of the Exchequer, said that the Government had given a great deal of time to the examination of the position in relation to the express vessel which was laid down by the Cunard Company and on which work had been suspended. He was sorry to see in the daily Press the other day a definite statement about the resumption of work which was not justified by any fact; yet it was the case that the Government had not shut the door to assistance in some form or another which would enable the completion of that vessel. Assistance would have to be dependent on the fulfilling of certain conditions which would seem to be essential if the objects for which the vessel was originally laid down were to be attained. Those conditions would include among other things the consolidation of existing British interests. The matter was, he said, being actively pursued. The reference to a consolidation of British interests is taken on good authority to relate to the conversations which have taken place between the Cunard Company and the White Star Line with regard to an arrangement over the working of their fleets. There has been no definite outcome from these conversations, but it is understood that Government help will be conditional on some arrangement being made.

The Iron and Steel Institute.

THE Council of the Iron and Steel Institute announces that Mr. Kenneth Headlam-Morley has been appointed Secretary in succession to Mr. G. C. Lloyd, who will retire shortly after an association of about thirty years with the Institute. Mr. Headlam-Morley will take up his duties about the end of June of the current year. He is the only son of the late Sir J. W. Headlam-Morley, the former Historical Adviser to the Foreign Office, and was educated at Eton, and at Oxford, where he was a scholar at New College and took honours in Literature, Humanities, and History. In 1925 he joined the staff of Dorman, Long and Co., Ltd., and after a technical training in their iron and steel works at Middlesbrough was occupied in their secretarial, managing director's, and by-products departments. He has travelled extensively in France and Germany and is well acquainted with the iron and steel industry of Western Europe.

The Coal Utilisation Council.

WE have received a booklet setting forth the aims of an association known as the Coal Utilisation Council, which has recently been formed by the joint action of colliery owners, wholesalers, merchants, and exporters to further the greater consumption of coal. The work of the Council will fall naturally into two parts: research and propaganda. The former will not be confined to laboratory work alone, but will include all problems concerned with the preparation and consumption of coal and the state of the market. As far as distribution is concerned, a survey will be made of methods of handling coal at the pithead, of its transport by land and water, of its handling and storage at depôts, and the methods adopted for its delivery under various conditions. In addition, the needs, views, and problems of consumers will be inquired into. A department is to be set up to examine appliances for the better utilisation of coal. The Council is assured of the help and goodwill of the various scientific bodies, such as the Fuel Research Board, with which it hopes to co-operate. The Council has already got into touch with associations and individuals in foreign countries, with whose aid it is hoped that a thorough investigation of the export trade may be made. In this connection it is intended that a comparison shall be made of British and foreign methods of coal distribution in order to ascertain whether any of the latter might be profitably applied in this country.

The Manchester Ship Canal.

THE report of the directors of the Manchester Ship Canal, which was issued at the end of last week, shows that the net receipts for the whole undertaking were £640,531, leaving a net revenue for the year of £569,916. There was a decrease of £72,453 in the receipts from the Ship Canal tolls, ship dues, and miscellaneous receipts, and a decrease of 578,647 tons in the weight of sea-borne traffic upon which Ship Canal tolls were paid, as compared with the year 1931. During the past year there were decreases under practically every head of expenditure with the exceptions of dredging, which showed an increase of £13,676, compared with the previous year. This increase was largely brought about by the abnormal expenditure, amounting to £16,000, which it was necessary to incur in dredging the entrance channel to the river Mersey at Eastham. The total revenue from the Bridgewater canals, railways, &c., was £5178, compared with £5672 for 1931. Good progress has been made with the construction of the additional oil dock at Stanmore, Ellesmere Port, and the work is now approaching completion. The wharf and lay-by adjoining the works of the Lancashire Steel Corporation at Irlam have been completed and are in use, as are the alterations to the company's railways between the new wharf and Glazebrook Junction. The approximate receipts of the Canal for last month showed an increase of over £4000 compared with those of January, 1932.

New Olympia Scheme.

As the result of a scheme announced this week by Mr. Philip Hill, the chairman of Olympia, Ltd., the accommodation of Olympia is to be doubled by the erection of a new building. Other improvements, including moving the Addison-road Station to the centre of the group of buildings, are to be made, and the completed Olympia will be the biggest exhibition centre in Europe. The site has already been acquired, the demolition of the existing buildings is in progress, while the plans for the new building are going before the London County Council immediately. It will be erected on a site of 7¼ acres on the south side of the Hammersmith-road, slightly nearer the West End than the existing building. It will have frontages of 450ft. to Hammersmith-road and 600ft. to Warwick-road. The total frontage to main streets will thus be nearly twice the Hammersmith-road frontage of the existing buildings. The frontage to Hammersmith-road will be considerably recessed behind the general line of buildings in the street to provide adequate drawing-in space for cars, an omnibus station, and taxi-cab ranks. Addison-road Station—the connecting link between the three north main line railways, the Southern Railway, and suburban lines—is to be moved from its present site to a position in the centre of Hammersmith-road bridge, which will put the station right in the centre of the Olympia group of buildings, to which it will be connected by subways and bridges. Sidings and goods yards will be provided adjoining the building. It will be possible, therefore, for goods to be loaded into a train in any part of the country and actually unloaded in Olympia, where 50,000ft. of space for unpacking will be provided, while lorries may be driven into the building through four entrances each 30ft. wide. The new building will be connected to the existing Olympia building by a subway and exhibition galleries.

The Chamber of Shipping.

THE fifty-seventh annual meeting of the Chamber of Shipping of the United Kingdom took place on Thursday, February 16th, when the annual report was presented and Mr. W. J. McAlister, the newly elected President, gave his address. Mr. Daniel Radcliffe was elected Vice-President for the ensuing year. Resolutions dealing with the following matters were passed. The Chamber of Shipping expressed its full accord with the declared policy of his Majesty's Government of using the forthcoming World Economic Conference for the purpose of re-establishing a prosperous world trade, and measures to bring about this desired end were urged. The passing of the Merchant Shipping Act, 1932, and the Revised Board of Trade Regulations regarding the Safety and Loadline Convention were welcomed, and the pressing need for bringing into operation internationally other existing conventions was stressed. With regard to wireless communication at sea, the decision of the International Conference held in Madrid in 1932, to maintain substantially intact the wave bands used by the mercantile marine, was welcomed. Attention was called to the vital necessity of the coal industry to shipping, and the Chamber stressed the importance of any future legislation or regulations dealing with the coal industry being only such as would encourage and not discourage efficiency. The proposals of the Salter Report, in so far as their adoption would be calculated to promote full and equal opportunity for the development of every form of internal transport by road, rail, or coastal shipping, were welcomed by the Chamber.

Railway Wages.

ON Monday last, February 20th, the British railway companies issued an official denial of a report which appeared in certain sections of the daily Press, that a reduction of the railwaymen's wages to the extent of the findings of the chairman of the National Wages Board was to be enforced, and that in a few days' time the requisite notices would be served. The position remains as it was immediately after the refusal of the unions to accept the chairman's finding, and this position was outlined in our Journal note of February 10th. It will be recalled that, although they have taken no steps to put the chairman's finding into operation, the companies have advised the unions that, having, in their judgment, fulfilled the obligations placed upon them by the Act which constituted the National Wages Board, they must now proceed to consider afresh the situation which has been created.

F.B.I. and Civil Aviation.

ON behalf of the Federation of British Industries, Mr. Guy Locock, the director, sent on Monday last, February 20th, a letter to the Prime Minister setting forth the views of the Federation on the control of civil aviation, which subject is now being discussed at Geneva. The Federation considers that, from the industrial point of view, a proposal to internationalise civil aviation has the following grave disadvantages:—It will endanger the free development of Empire air routes under British auspices, which is of the highest importance to the Empire, both from the political, social, and business point of view. Civil aviation is still in its infancy, but it has already proved its great importance as a means of maintaining contact between the various parts of the Empire, and to no interest is this more important than to the business community. The future of the aeroplane construction industry and of the internal combustion engine, as applied to aeroplanes, depends on the free play of British inventive genius and organisation. International control will hinder this and will prevent the British aircraft industry from playing that part in the world to which its past achievements have entitled it. Both from the point of view of Imperial air communications and from that of the serious effect upon British industry, the Federation would ask that no binding commitment shall be entered into by His Majesty's Government without British industry being given the opportunity of expressing its views to the Government upon any such proposals before they are accepted.

The Yorkshire Electric Power Company.

AT the forty-first ordinary general meeting of the Yorkshire Electric Power Company, held in Leeds on Tuesday, February 21st, the chairman, Mr. Robert Armitage, explained that the efficiency of the undertaking was steadily increasing. The recent extensions and alterations at the Thornhill station had brought it into the front rank of efficient power stations, whilst the Electricity Commissioners' returns for 1931 showed that the Ferrybridge station was the most efficient, in respect of fuel consumption, in the Mid-East England Area. A further important stage in the efficient production of electricity had been reached. In 1932 the Central Electricity Board completed its arrangements for the Mid-East England Area, and on January 1st last it began the control of generation by the authorised undertakers in that area. The object of the scheme was to obtain the maximum economy in the generation of electricity. The company had undertaken to supply electricity for all purposes in an area of some 760 square miles adjacent to its present area. It was authorised to do so by a special Electricity Act, which required that it should be operated by a company incorporated under the Company's Act of 1929, and the North Lincolnshire and Howdenshire Electricity Supply Company, Ltd., had been registered for the purpose. The new company would begin operations forthwith with a scheme of development which provided for the establishment within three years of distribution centres to supply districts containing about three-quarters of the population in the area.

This new bridge at Brisbane appears to be constructed in monolithic concrete. Actually, however, structural steelwork is encased in concrete.

New Bridge at Brisbane, Australia.

CONCRETE has been introduced within quite recent years as a new material for bridge building, and its use, combined with structural steel work, appears to be extending to larger erections than were at first contemplated. The recently opened Grey-street Bridge over the river at Brisbane, Australia, is a typical example of the type which certainly, for the intermediate size of bridge too small to give an effect of grandeur from mere scale, seems to have a better æsthetic appearance than naked steel work. This new bridge, illustrated by an aerial photograph reproduced at the head of this page and by other views on page 196, has a total length with its approaches of 1634ft. It crosses the river on three arches, each of 238ft. span, and the lower North Quay-road on two reinforced concrete spans of 33ft. centres. It is approached from the south by a curved ramp supported on sixteen approach spans, varying between 34ft. and 45ft. in length, built up of broad span beams encased in reinforced concrete. A reinforced concrete spandrel arch of 92ft. span connects the upper end of the ramp with the bridge proper. At the northern end the bridge forms a continuation of Grey-street on the high level, while two ramps, one on each side, lead down to the North Quay-road beside the river. The roadway across the bridge accommodates four lines of traffic, and the overall width of the deck, which, at its centre is 56ft. 6in. above low water level, varies from 66ft. to 80ft. The bridge proper, as may be seen from the illustrations on page 196, is constructed of steel arches encased in concrete, from which the decking is supported by stringers. Rock foundations for the piers were found at a maximum depth of 107ft. below high water level and the greatest height—maximum depth of foundation to top of arch—is 191ft.

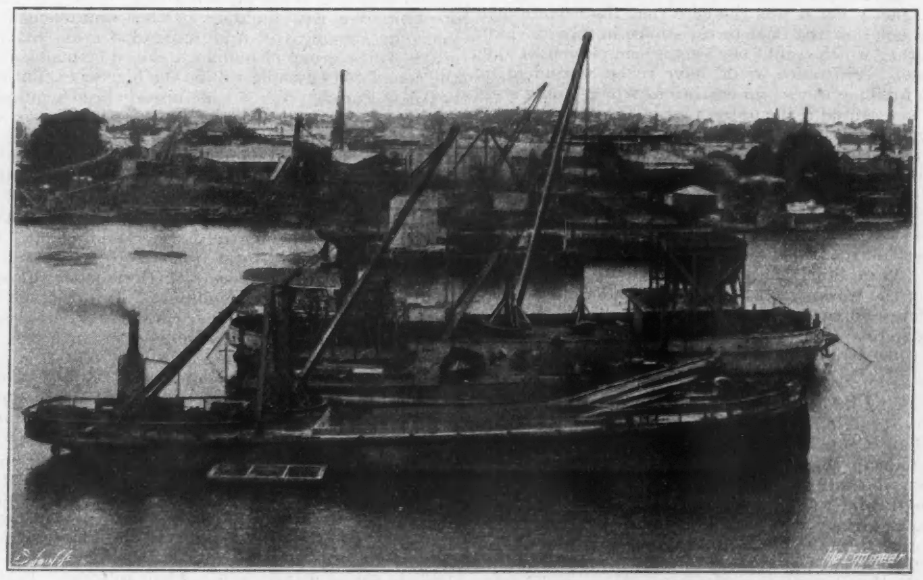
FOUNDATIONS.

As far as the actual work of erection was concerned, little difficulty was encountered in forming the foundations for the approach viaduct on the south. But the very large number of piles that had to be driven in order to provide support for mass concrete work necessitated the provision of a large amount of plant. Consequently, it was found necessary to work continuously twenty-four hours a day in shifts. Foundations for the river piers and for the south abutment were, however, more difficult to build. Each river pier is supported on two reinforced concrete cylinders, 28ft. in diameter at the cutting edges, sunk to a maximum depth of 107ft. below high water, while the south abutment pier is built on two reinforced concrete caissons, each 20ft. by 34ft., carried down to a depth of 83ft. below high water. These cylinders and caissons were built, as to the first stages, on artificial sand islands constructed at the site, a method suggested by Mr. M. R. Hornibrook, of the Brisbane firm of that name, which carried out the work, and believed to be new to Queensland. Work in progress on the foundations for the river piers may be seen in a photograph reproduced on this page. The cylinders were sunk by open dredging through the sand islands and river bed. They were built up at intervals as the progress of the sinking operation required. When the cutting edges were within a few feet of the rock, air locks were fitted to permit workmen to go below and the cylinders were finally sunk and bedded into the rock by manual labour. Once founded, they were filled solid with concrete. Work under compressed air on the six foundations occupied a total time of six months, although operations were continuous, twenty-four hours a day. In spite of the great depth and the necessary high air pressure, no fatal case of caisson disease occurred, nor was any man permanently disabled. Every precaution was taken to ensure the safety of the men and a medical officer was attached to the contractor's staff. Cases of caisson disease were treated in a medical lock placed at the doctor's disposal.

After the concrete cylinders had been sunk, a considerable amount of work was involved in connecting together the tops of each pair. Headstocks of granite masonry, each 96ft. long by 20ft. wide and 9ft. 9in. deep, had to be constructed, and taken down to a depth of 18in. below low water. As it was considered impracticable to carry out this work in the wet condition, the whole area necessary for the construction of each headstock was "boxed" off and kept dry. For this purpose fifty piles were driven into the bed of the river to support the cofferdam or to hold it down against the effect of its own buoyance, according to the state of the tide and to the amount of material placed in position within it. As soon as the construction of the piers had been carried above high water level, the remaining work presented little difficulty, and could be carried out by more or less standard building methods.

ERECTION OF THE RIVER SPANS.

It has already been noted that the three main spans over the river are of arch construction. Two arch ribs for each span were erected in skeleton form in structural steel as three hinged arches, and after erection were given the appearance of monolithic construction by encasing them in reinforced concrete. The deck system consists of reinforced concrete slab work supported on structural steel cross girders and stringers cased in gunite, whilst the road surface is of asphaltic concrete. A crane travelling from end to end of the river spans erected the structural steel of the deck work. The arch ribs, which were constructed by Evans, Deakin and Co., Ltd., were supplied in sections weighing up to 11 tons each.



Reinforced concrete cylinders, two for each pier, were sunk by open dredging and manual labour under air lock. They were founded on rock at depths up to 100ft. below high water.

The first section of each half-arch was mounted on its pin near the water level at the base of the pier, and the remaining four sections supported by timber staging at the water level were progressively connected to it. On the completion of the riveting operations suitable tackle of wire ropes, guys, masts, blocks and winches was rigged up, as can be seen in the photographs reproduced on page 196, and the half arches were hoisted up and lowered away again until they bore against one another at the crown pins, and became self-supporting. The concrete covering of the arch ribs was cast in voussoir sections, which were set in position in a pre-arranged order, so that the steel work would not be too heavily loaded at any one place. To a certain extent operations on any one span were allowed to proceed ahead of those on an adjacent span, but not sufficiently far to endanger

the stability of the intervening pier. As finished, each arch is 5ft. wide throughout, 10ft. 8½in. deep at the haunch, and 6ft. 7in. deep at the crown. The rapidity with which this part of the work could be performed is illustrated by the fact that the bridge was finished less than fourteen months after the erection of the structural steel ribs for the first arch.

Altogether more than 7000 tons of cement and 45,000 tons of sand, gravel, and crushed metal were required for the construction of the bridge and its approaches. The contractors for the work were M. R. Hornibrook, Ltd., of Brisbane, and the designing and supervising engineer Mr. A. E. Harding Frew, M.I.E. (Aust.). The bridge is estimated to have cost £420,000 to build.

The British Industries Fair at Birmingham.

No. II.

(*Continued from page* 168, *February* 17*th*.)

THE BRITISH THOMSON-HOUSTON COMPANY, LTD.

THE stand of the British Thomson-Houston Company is considerably larger than usual, and by reason of the special lighting effects, for which over 600 standard Mazda lamps are used, it constitutes a landmark of the Electrical Section of the Fair. Among the engineering exhibits are variable-speed A.C. motors. A commutator machine, with shunt characteristics, is shown, together with push-button control gear and speed indicator mounted on a pedestal. "No lag" motors, which work at unity or leading power factor, and fractional horse-power motors, ranging in size from $^1/_{100}$ to 1 H.P., are also exhibited. There are four types of electric gramophone motors—the "Synchro-Blue," the "Golden-Disc," the "Truspeed," and the "Universal," all designed for long life, freedom from magnetic hum or other noise, and designed to eliminate interference with radio or radio gramophone reception.

A new device shown for the first time is an electro-hydraulic "Thrustor," for giving a smooth straight line

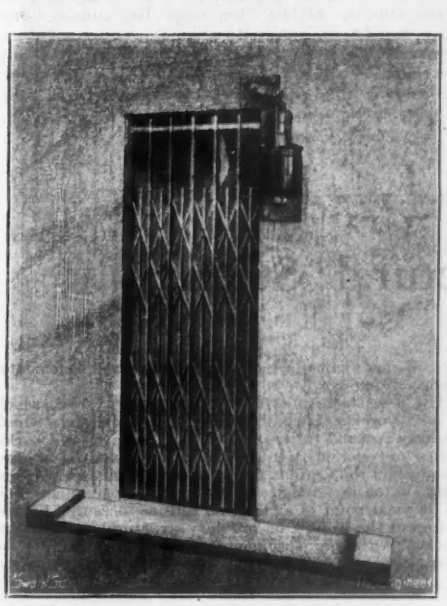


FIG. 8—"THRUSTOR" OPERATED GATE—B.T.H.

thrust through a given stroke. One of its applications is that of gear-changing on heavy machine tools, control being effected from the working point. In all cases where a steady pressure is required, such as for baling presses, laundry presses, spotwelding machines, or stamping machines, the device can be operated by a foot-operated push-button, thus giving the operator maximum control over the operation being performed. On the stand a Thrustor is used in conjunction with a Mazda photo-electric cell, to open and close an expanding gate—Fig. 8. As the gate is approached a beam of light is interrupted, thus causing the photo-electric cell to set the Thrustor in motion, and, in turn, it operates the gate.

Besides B.T.H. "Mag" generator lighting equipments for motor cycles and motor-cycle magnetos, there is one of the firm's latest sound-amplifying equipments for providing music from gramophone records. The amplifier is remarkably light and compact, weighing only 38 lb. and measuring 13in. by 14in. by 8in. high, yet giving an undistorted output of 10 watts. By means of a microphone attachment speech can be relayed when required. Another new development in B.T.H. sound equipment is a 5-watt gramophone amplifier, which has been designed mainly for reproducing gramophone records in cafés, hotels, &c., where a light, portable equipment is required.

GEORGE KENT, LTD.

Meters and control apparatus of every kind are to be seen on the stand taken by George Kent, Ltd., of Luton. Some of the exhibits that particularly attract the attention are a master control panel for use on the automatic boiler control system evolved by the firm; a complete range of panel-mounted instruments for boiler-houses; temperature, pressure and flow controllers not previously exhibited, and a range of steam, air and gas meters, designed to ensure economical running of industrial plants.

Among the last-named exhibits there is the recorder illustrated in engravings Figs. 9 and 10, which

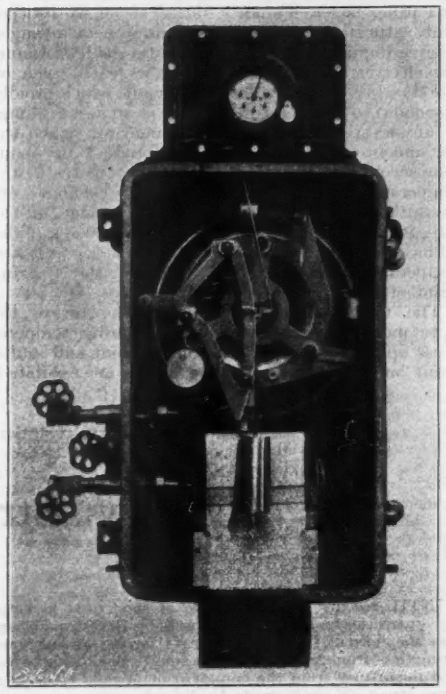


FIG. 9—LOW-PRESSURE GAS-FLOW RECORDER—KENT

has been specially designed for low-pressure air or gas measurement, particularly where there is heat or vibration. It consists essentially of a large diameter tube, bent into the form of a ring so mounted as to be rotatable about the axis of the ring. This tube is partially filled with oil, and there is a division plate in the upper segment. The differential pressure generated by the flow of gas in the main past an orifice, or any other suitable differential producer,

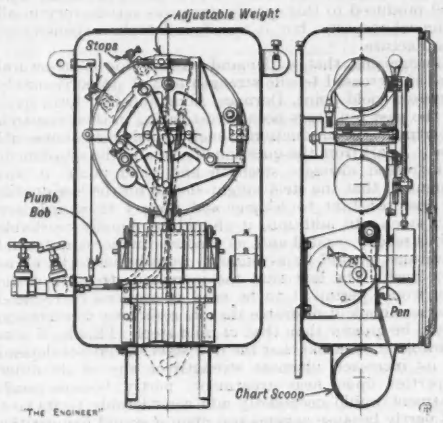


FIG. 10—CONSTRUCTION OF GAS-FLOW RECORDER

is measured by leading pipes from each side of the orifice to each side of the division plate in the tube. Acting upon the area of the division plate this differential pressure causes the ring to rotate. It will be seen that the function of the oil within the tube is only to seal the pressures on the respective sides of the division plate, so that variations in the specific gravity, the viscosity, or the level of the oil, have no effect upon the accuracy of the measurement. In order to obtain a diagram equally spaced in terms of flow, when the pen is connected directly to the tube, a specially arranged restoring moment is provided. The differential pressure across the orifice in the pipe line varies as the square of the flow, and its effect upon the ring is balanced by a gravity weight, the supporting thread of which lies against the face of a cam accurately ground, so that the control force also increases as the square of the flow. As the whole system is in neutral equilibrium, the control weight may be changed if desired to alter the maximum differential head that may be measured. The differential pressure at full flow may be 4in., 2in., or 1in. water gauge, and in certain cases only ½in. On overloads, under which condition the excess rotation of the ring is prevented by stops, the oil will continue to seal within the ring, until 8in. water gauge differential is obtained, after which it releases the differential and subsequently returns to the correct zero when the flow subsides. The maximum pressure for which the standard meter is built is 30 lb. per square inch. It is claimed that standardisation in manufacture has reached such a pitch that even a meter that has been deliberately deranged in every adjustment can still be reset to gauges only, and will then maintain its accuracy without recalibration. The chart is of roll form and lasts 4½ weeks at normal speed. The pen travel is 4½in., and spacing is equal across the chart down to one-twelfth of full flow. Change wheels are supplied for driving the chart at 1in., 2in., or 3in. per hour, the power being supplied either by an eight-day spring clock, or an A.C. motor clock. From the engravings it will be seen that besides the recorder there is also a counter and an indicator. The meter is designed to withstand heat, dust, and vibration, and is also fume-proof.

PEGSON.

Two models of the "Livewire" vibrating screen, which we have on more than one occasion described in our columns, are exhibited by Pegson, of Coalville, Leicestershire. One of the screens is arranged at a very flat angle with the object of demonstrating how very little headroom is required, and how the

FIG. 11—INTERNAL COMBUSTION RAMMER—PEGSON

machine will work efficiently in confined spaces. The makers claim that it is the only screen of the vibrating type which, when working at a flat angle, will give efficient screening and large outputs. The shaking table made by the firm for the rapid consolidation of concrete is also to be seen, but perhaps owing to the fact that it is an entirely new production, the internal combustion rammer illustrated in Fig. 11 will arouse the greatest interest. This machine, it is said, can be operated quite easily by any man capable of using the old type of hand rammer. Since it works on the internal combustion principle, it is entirely self-contained, and there are no air lines to impede the operator. In addition, of course, it has the advantage that it is not dependent upon any other machinery, such as a compressor, and may therefore be used in places to which it would be very inconvenient to transport other machinery. The engraving sufficiently illustrates the neat design of the device and indicates its general features. The maximum number of blows delivered per minute is ninety, but

the operator is not only able to control the rate at which they are given, but also the force behind each individual blow. Control is effected from the handle bar. Raising this bar to the highest position fires the explosive charge, while the force of the blow is regulated by the weight of the hands on the bar. If the pressure applied is heavy, a full charge of gas is drawn into the cylinder, with the result that a heavy blow is delivered, while a light touch produces a light blow. Thus control of the machine is effected in a manner that comes naturally to the operator.

A rather attractive exhibit on the stand is a working model of a quarry on which a number of new and interesting machines are being demonstrated.

CAMBRIDGE INSTRUMENT COMPANY, LTD.

Typical groups of newly designed flush-mounted instruments, arranged on panels as they would be actually installed in a power plant or works, are being shown by the Cambridge Instrument Company,

FIG. 12—FLUSH MOUNTED INSTRUMENT PANEL —CAMBRIDGE

of Cambridge. One panel—Fig. 12—carries six flush-mounted instruments comprising an indicating thermometer, a draught gauge, electrical CO_2 indicator, pressure recorder, electrical distance thermometer indicator, and a potentiometric recorder, giving continuous records of temperatures measured by thermo-electric pyrometers. A second panel—Fig. 14—comprises an index thermometer, a draught gauge, a three-pen pressure recorder, and a four-unit

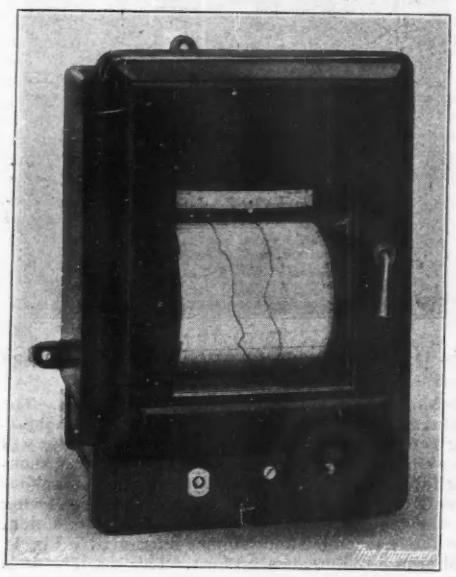


FIG. 13—THREAD RECORDER—CAMBRIDGE

indicator, giving readings of draught, CO_2 percentages and temperatures measured by both the thermo-electric and the electrical distance methods. A third panel carries three indicators of a new type, in which the pointer is fixed, and the scale, which is illuminated and magnified, moves past the pointer, Two of these indicators show temperature measurements, while the other is arranged to indicate CO_2 percentages.

The temperature-measuring instruments shown cover a wide range of application. Various patterns of the firm's "Easy-to-read" dial thermometers are shown, suitable for steam plant, refrigerating plant, jam boiling, &c. These thermometers are of the vapour pressure type, and have been introduced to meet the demand for efficient and easily read dial thermometers which are more robust than glass thermometers. They may also be adapted for the automatic control of temperatures, and in this connection it should be mentioned that there is an effective gas regulator and a dial thermometer fitted with special contacts for use in conjunction with a Bray contactor.

A combined temperature and humidity recorder exhibited gives simultaneous records of both temperature and humidity on a single chart, and is particularly suitable for use in connection with the manufacture and storage of products which may require definite atmospheric conditions for effective working or preservation. The temperature-recording mechanism is of the mercury-in-steel type, and has a specially sensitive bulb, whilst for recording the humidity, advantage is taken of a property of gold-beater's skin, which varies in length with the humidity of the surrounding atmosphere. The variations in the length of the skin are communicated by special mechanism to the humidity-recording pen, and are recorded on the chart as a percentage relative humidity. The standard instrument, with two pens, has a humidity range of 30 to 100 per cent. saturation. A single pen instrument arranged to give humidity records only is also made. Among the electrical distance thermometers to be seen on the stand is a quick-acting instrument, which rapidly responds to temperature changes, steady readings of any temperature within the range for which the instrument is designed being obtained in about four seconds after exposing the thermometer to the temperature, while small temperature changes are instantly registered. If desired, the range of the indicator scale can be reduced to about 20 deg. Fah., giving very open graduations around any selected temperature, such as, for example, the freezing point of water.

The thermo-electric pyrometers shown are the type most generally used for measuring temperatures up to 1400 deg. Cent. Single-point and multi-point indicating and recording outfits are exhibited, including a new form of indicator in which the scale moves past a fixed pointer. This indicator has a highly magnified scale which is easily readable from considerable distances. Portions of the scale can be coloured differently to indicate when the readings are too high or too low.

An inexpensive form of thread recorder (Model B) —Fig. 13—is another exhibit. Originally designed for single-point recording only, it has recently been modified so as to provide simultaneous records from

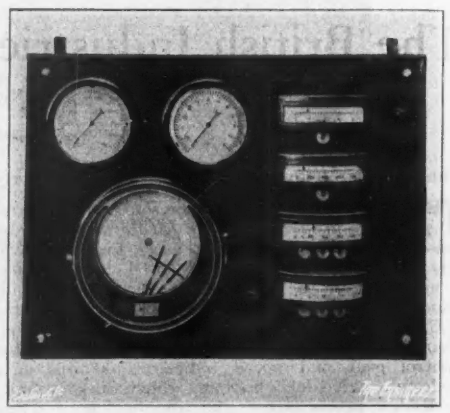


FIG. 14—INSTRUMENT PANEL—CAMBRIDGE

two points, and an interesting feature of the instruments is that the records are distinguished by different rates of dotting. There are many useful types of pyrometers designed for the measurement of surface temperatures, and radiation and optical pyrometers for the measurement of very high temperatures. Other exhibits of the Cambridge Instrument Company consist of automatic temperature regulators, electrical CO_2 recorders, pressure and vacuum recorders, a smoke density recorder, a dew-point recorder for flue gases, a dissolved oxygen recorder, and a portable vibrograph.

(To be continued.)

A New Structural Steel.

UNTIL recently the only grade of steel used in large quantities for structural purposes by British engineers was the normal type of mild steel having an ultimate strength of from 28 to 33 tons per square inch. One of the first departures from the employment of mild steel on a large structural scale made by British engineers was in the construction of Sydney Harbour Bridge. Of the 38,000 tons of steel in the arch portion of that structure some 27,000 tons are of a special high-tensile steel made at Messrs. Dorman, Long's Middlesbrough steel works. This high-tensile material, a silicon steel, was made to the specification of the New South Wales Public Works Department and was required to have an ultimate strength of 80,000 lb. to 95,000 lb.—or 35·7 to 42·4 tons—per square inch and a minimum yield point of 20 tons. The minimum reduction of area specified was 35 per cent. and the minimum percentage elongation on 8in. was defined by the ratio of 1,600,000 to the ultimate strength in pounds—that is to say, 20 for steel of the lower limit of tensile strength and 16·8 for steel of the upper limit. The steel produced to this specification was satisfactory in all technical respects, but it was found to be expensive to manufacture.

Recognising that a demand existed for a structural steel of increased tensile strength and of proportionately increased yield point, Dorman, Long and Co., Ltd., have for the past ten years been investigating in their research department the production of such a steel on a commercial basis. Apart from the question of cost and the attainment of increased ultimate strength and yield point, it was recognised that the steel sought should not be less ductile nor less resistant to fatigue and impact than ordinary mild steel. In addition, it should be equally workable and as readily welded and, as produced under commercial conditions, should be as uniform from batch to batch as mild steel. The fact that the increased strength of the steel would permit it to be used in sections of reduced thickness made it desirable that its resistance to corrosion should be greater than that of mild steel. Finally, it was desirable or essential that the new steel should not depend for its increased ultimate strength or any of its other properties upon heat treatment, partly because such treatment would necessarily add considerably to its cost and partly because dependence upon it would hamper the subsequent fabrication of the steel by any process involving the application of heat to it.

On the Continent a patented high-tensile steel known as St. 52 was introduced a few years ago by the combination of German steel works known as the Vereinigte Stahlwerke, and has since been very successfully applied to structures of all kinds. This steel has a tensile strength of 33 to 39 tons per square inch, a yield point of over 22 tons, and an elongation of about 20 per cent. on 7·8in. A typical analysis is:—Carbon, 0·15 per cent.; copper, 0·5–0·8; chromium, 0·4 max.; manganese, 0·8 max.; silicon, 0·25 max. With this steel the regulations of the German State Railways permit working stresses 50 per cent. higher than those allowed for standard continental grades of mild steel.

The new steel, known as "Chromador" steel, which Messrs. Dorman, Long, following the investigations which we have referred to, are now able to offer in the form of plates and sections would appear to represent a definite advance on the German St. 52 steel. It has a guaranteed ultimate tensile strength of 37 to 43 tons per square inch and a yield point of at least 23 tons as measured by the "drop of the beam" on ordinary structural sections ¾in. thick. With ¾in. specimens its elongation on 8in. is guaranteed at a minimum of 17 per cent. and its reduction

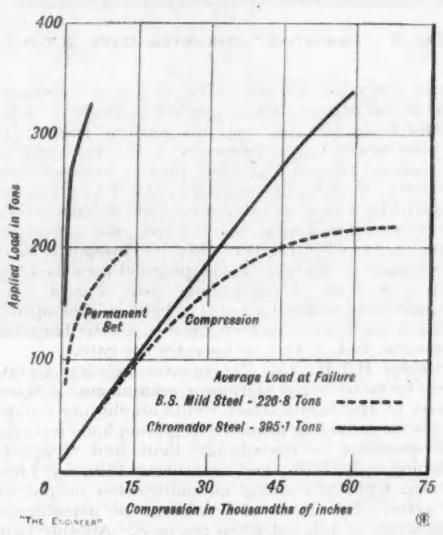


FIG. 1—COMPRESSION TESTS ON ROLLED BEAMS

of area at 40 per cent. minimum. The steel, it is claimed, will withstand the cold bend tests specified by the British Standards Institution for grade A steel. The chemical composition of "Chromador" steel is as follows:—Carbon, not exceeding 0·3 per cent.; manganese, 0·7–1·0; chromium, 0·7–1·1; copper, 0·25–0·5; silicon, not exceeding 0·2; sulphur, not exceeding 0·05; phosphorus, not exceeding 0·05. The outstanding differences between the chemical compositions of "Chromador" steel and St. 52 steel are therefore the higher chromium and the lower copper content of the British steel.

In the following table we reproduce the test results obtained with "Chromador" steel plates by the Sheffield Testing Works, Ltd. In this table the symbol L refers to specimens cut with their lengths parallel with the direction in which the plates were rolled and X to specimens cut across the direction of rolling The steel in all cases was tested in the "as-rolled" condition without normalising.

Tensile Test Results.

Specimen.	Ult. stress.	Elong. on 8in.	Red. of area.	Yield point.	Y.P./ult.
	T./sq. in.	Per cent.	Per cent.	T./sq. in.	Per cent.
1in. plate, L ..	40·05	24·4	58·1	22·85	57
X ..	41·11	21·6	52·2	22·74	55·3
¾in. plate L ..	36·34	26·9	61·3	23·75	65·4
X ..	36·33	25·8	57·3	23·54	64·8
¾in. plate L ..	40·46	22·1	64·2	23·47	58·0
X ..	40·39	18·3	50·9	26·40	65·4
½in. plate L ..	41·68	20·0	53·9	27·20	65·3
X ..	41·06	17·8	51·5	28·32	69·0

Similar tests on similar specimens cut from the same plates and machined together have been made by Messrs. David Kirkaldy and Son and by the National Physical Laboratory. The results are in very close agreement with those given above. From the figures given in the last column of the table it will be observed that the yield point of the steel bears at least as good a ratio to the ultimate strength as it does in ordinary structural mild steel.

Numerous comparative tests have been made on "Chromador" and ordinary mild steel rolled beams or full-sized built-up members, the equipment employed being the Avery 1250-ton testing machine which Messrs. Dorman, Long installed at their works in connection with the Sydney Bridge contract. In Fig. 1 we reproduce the test results obtained on 10in. by 8in. British standard rolled beams weighing 55 lb. per foot run. The specimens

FIG. 2—ROLLED BEAMS AFTER TESTING

were 7ft. 8in. in length. They had flat ends and were tested in compression with axially applied loads. The compression curves represent the average of three tests and the permanent set curves the average of two tests. The average load at the point of failure of the "Chromador" steel beams is seen to be 1·74 times that at the point of failure of the ordinary mild steel beams. The permanent set of the mild steel beams under a load of 200 tons is twice as great as that of the "Chromador" beams under 330 tons. Similar compression tests were carried out on beams of the same section but with lengths of 15ft. 4in. and 23ft. The curves obtained were of the same character as those reproduced in Fig. 1. For the 15ft. 4in. beams the average load at failure of the "Chromador" specimens was 1·62 times the average load at failure of the mild steel specimens and for the 23ft. beams the ratio was 1·45.

Other tests were carried out with 16in. by 6in. British standard beams weighing 50 lb. per foot. The specimens were tested in the form of freely supported spans of 12ft. with the load applied at the centre of the span. The average of three tests on "Chromador" specimens showed a load at failure of 40·1 tons, as compared with 26·2 tons, the average for three mild steel specimens, representing a ratio of 1·53. In Fig. 2 we illustrate the six specimens after they had been tested. The three upper specimens are the mild steel beams and the three lower specimens the "Chromador" beams. In all six cases the beams were loaded up to the point of failure as defined by the attainment of the maximum load. This point was quite sharply indicated by the testing machine. It is noteworthy that the degree to which the "Chromador" beams were bent at the point of failure was much less than that of the mild steel beams, in spite of the fact that the load at the point of failure of the "Chromador" beams was some 50 per cent. greater than the load at the point of failure of the mild steel beams.

In Fig. 3 we illustrate a built-up member in "Chromador" steel under compression in the 1250-ton testing machine.

The resistance of the new steel to corrosion was examined by testing it against ordinary mild steel by the customary short-time laboratory test involving the immersion of the samples in magnesium chloride solution, the samples being alternately exposed to the solution and dried over a period of three weeks. The results of this test are shown in Fig. 4. Each of the curves represents the average of three tests. It will be seen that at all stages of the test the loss in weight of the "Chromador" specimens was just about half that of the mild steel specimens. A closely similar result was obtained from another test involving the exposure of specimens of "Chromador" and mild steel plates in the "as-rolled" condition to the action of the river Tees at Middlesbrough at mean tide level over a period of twelve months.

It is argued by Messrs. Dorman, Long that a steel of increased tensile strength can be used with full effect in riveted structures only if rivets of proportionally increased strength are employed. This argument can be accepted

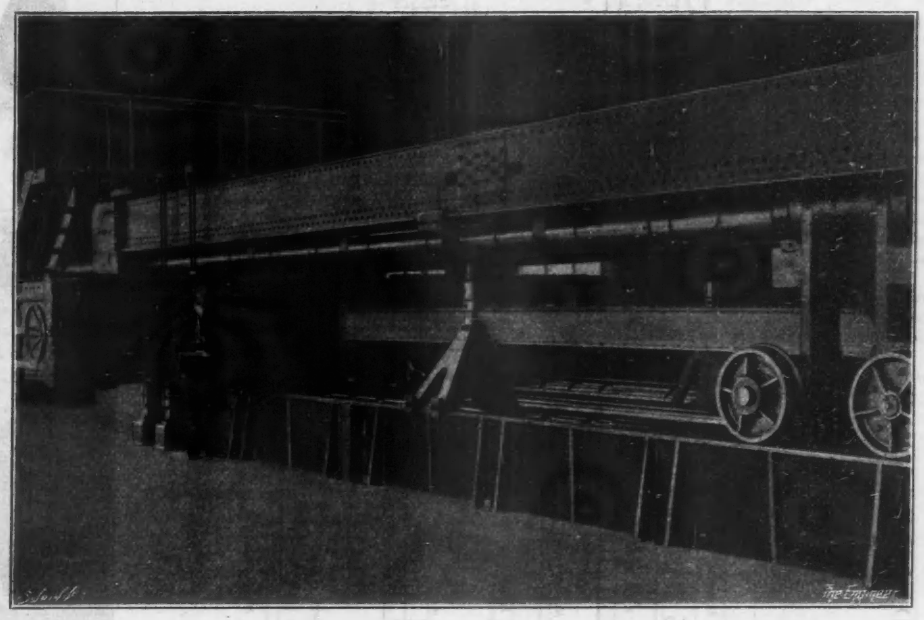


FIG. 3—BUILT-UP COMPRESSION MEMBER IN 1250-TON TESTING MACHINE

as generally true, but it is not, we think, wholly obvious. To take a simple illustration let us suppose that a given tensile load has to be transmitted through two plates united by a single riveted lap joint. If the permissible stress with "Chromador" steel is taken at 50 per cent. more than that with ordinary mild steel, then if "Chromador" steel is used the section of the plate members need be only two-thirds that necessary with mild steel. This reduction of section may be effected either by reducing the width of the plates or their thickness. If the width is reduced by two-thirds then the number of rivets in the joint must also be reduced by two-thirds, keeping their diameter constant, or their diameter must be reduced by two-thirds, keeping their number constant. Either way, the total shearing area of the rivets will be reduced and therefore the shearing stress upon them will be increased. Hence in this case it is essential to employ rivet material of greater strength with the "Chromador" steel than is necessary with the mild steel. If, however, the reduction of section of the plate members is effected by reducing the thickness of the plates, leaving their width unaltered, then, so far as the shear on the rivets is concerned, no change is necessary either in the number or diameter of the rivets or in the strength of the material of which they are made. The reduction in the thickness of the plates by one-third would, however, increase the bearing pressure on the rivets by 50 per cent. and might therefore necessitate the use of a rivet material of enhanced properties.

To a certain extent, therefore, the necessity for using improved rivet steel with structural steel of improved strength is dependent upon whether advantage is taken of the increased strength of the structural steel to reduce the width of the members fabricated from it or to reduce the thickness of the plates composing the members. Important design considerations are involved in this question. In some cases, for example the plating of a ship's hull, the conditions rule out all possibility of reducing the width or depth of the plating. A given area has to be plated and therefore the only means of taking advantage of the increased strength of the improved steel is to reduce the thickness of the plates. In the case of a built-up beam either the depth of the beam or the thickness of the flange and web plates might be reduced or a compromise might be sought by a partial reduction in both directions. If wind stresses are of major importance it might be held to be desirable to aim chiefly at the reduction in the depth of the beam. On the other hand, the governing consideration might be the reduction in the weight of the beam partly with a view to economising cost of materials and partly with a view to a saving in the cost of transporting the members to the site and of erecting them. The most economical solution of this problem would not of necessity lie in reducing the depth of the beam to the maximum possible extent.

As it is evident that in a number of cases, if not in all, full use of "Chromador" steel will require the employment of a rivet steel of proportionately increased strength, Messrs. Dorman, Long have developed such a rivet steel simultaneously with the development of "Chromador" steel. This rivet steel is of the same general nature as "Chromador" steel, but has a somewhat lower strength as tested before driving. As is well known, rivet steel after driving has a higher strength than before driving. For example, ordinary mild steel rivets with an ultimate tensile strength of 24·2 tons per square inch before driving have been found to show a strength of 28·7 tons after driving. It has been Messrs. Dorman, Long's object to produce a rivet steel which after driving will show a strength substantially equal to that of "Chromador" steel in the "as-rolled" condition. Full-sized comparative tests of members united with ordinary mild steel rivets and with the high-tensile steel rivets have been made in the company's 1250-ton testing machine. The test members failed by shearing of the rivets, and at the point of failure the mild steel rivets were supporting a shear of 25·6 tons per square inch, while the high-tensile steel rivets failed at a shear of 33·7 tons per square inch.

The new steel is intended for structural, including shipbuilding, uses. It is not at present being advanced for use in boilers or elsewhere involving its exposure to elevated temperatures, although we understand that its physical behaviour at such temperatures so far as is known is quite satisfactory. As a result of the small specimen and full-sized tests that have been carried out with it Messrs. Dorman, Long are satisfied that with its employment in bridges and buildings the permissible stresses allowed by the present standard specifications for the steel work of such structures could safely be increased by 50 per cent. It is obvious that no great economy would be secured by the use of the new steel if, accompanying an increase of 50 per cent. in the stress permissible with it, there were an increase of 50 per cent. in its cost per ton. It is therefore of importance as well as of interest to record that the cost of "Chromador" steel is only from 15 to 25 per cent. more than that of ordinary mild steel, the precise additional cost being dependent upon the section in which the steel is required. It may be asked why the extra cost of the new steel should be dependent upon the section in view of the fact that the price of ordinary mild steel already embodies

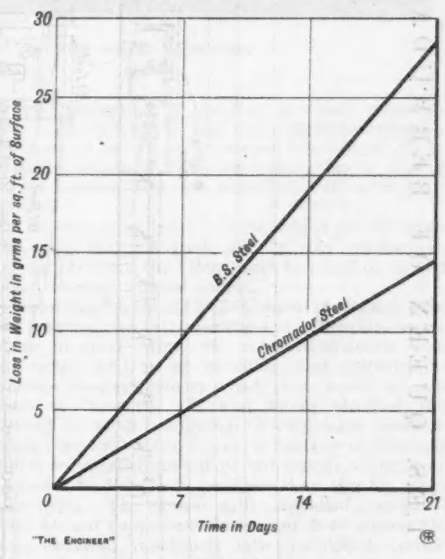


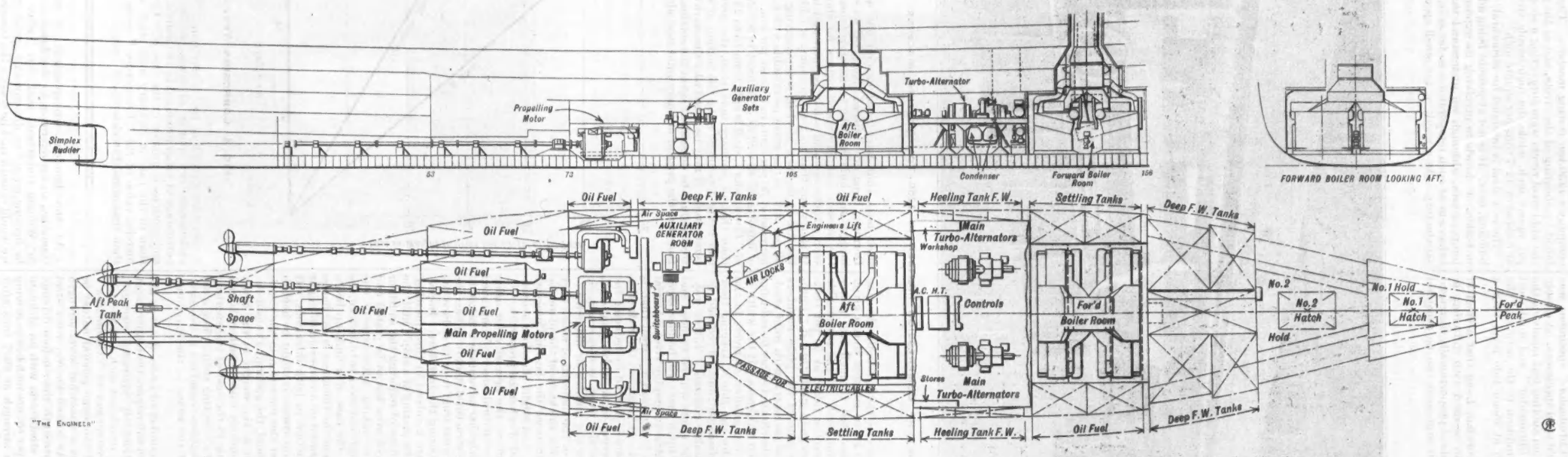
FIG. 4—CORROSION TESTS

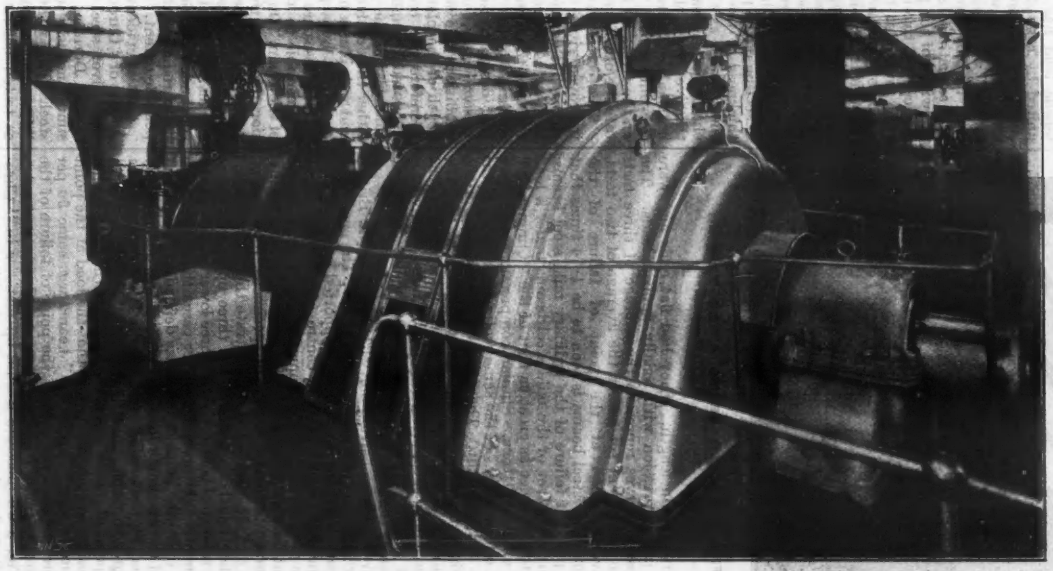
a variation according to the section. The answer, we understand, lies, partly at least, in the fact that the percentage of scrap produced in the manufacture of plates and sections is greater in the case of "Chromador" steel than in the case of ordinary mild steel, while the commercial value of the "Chromador" scrap is not greater than that of mild steel scrap.

As the London correspondent of the *Manchester Guardian*, in his reference to the death of Field Marshal Sir William Robertson, said that "after his retirement he became an active director in a great traffic concern," we would remark that he was on the boards of the London General Omnibus Company, the London Electric Railway Company, and the City and South London Railway.

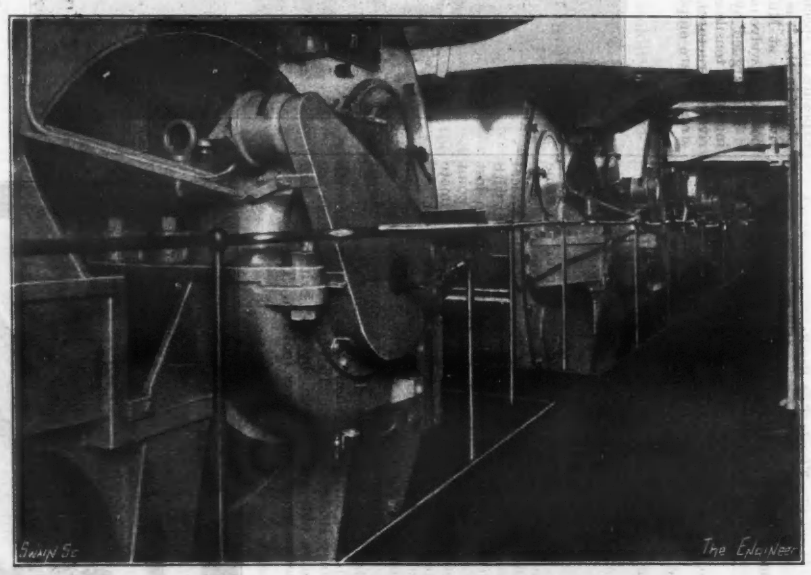
T.E.S. QUEEN OF BERMUDA—PROPELLING AND AUXILIARY EQUIPMENT

(For description see opposite page.)





ONE OF THE TWO TURBO-ALTERNATOR SETS



FORWARD END OF PROPELLING MOTORS

Turbo-Electric Liner Queen of Bermuda.

No. I.

THE quadruple-screw, turbo-electric liner "Queen of Bermuda," the successful trials of which ship were briefly referred to in last week's issue, is a British liner of outstanding merit, alike on account of her design, the short time in which she was built, the improvements in her passenger accommodation, and the lay-out of her propelling machinery. She has been built by Vickers Armstrongs, Ltd., at Barrow-in-Furness, for the carriage of passengers, mails, and refrigerated cargoes for the Furness-Bermuda Line of Furness, Withy and Co., Ltd., which is engaged in the company's New York-Bermuda trade. While primarily intended for this special service, she has also been planned to undertake long ocean cruises. Her design embodies several new features, which have been adopted following the excellent service given by her sister, the "Monarch of Bermuda." This latter ship was completed at the Walker Yard of Vickers Armstrongs, Ltd., in October, 1931, and a full account of the design of her hull and the propelling machinery was given in the issues of THE ENGINEER for November 27th, December 4th, and December 11th, 1931. As the new liner only differs in some details of passenger accommodation and machinery arrangement, we propose to confine our description to special features which will interest our readers, avoiding as much as may be possible the repetition of descriptions published in our preceding articles.

Below we give the principal hull dimensions, with particulars of the passenger accommodation and propelling and auxiliary machinery :

Hull Particulars.

Length overall	579ft. 6in.
Breadth moulded	76ft. 6in.
Breadth extreme	83ft. 6in.
Depth moulded to A deck	59ft. 9in.
Loaded draught	26ft. 3in.
Gross tonnage	About 22,500
Service speed	19½ knots
Designed speed on trials	19½ knots

Passenger Accommodation.

First-class passengers	731

Propelling Machinery.

Type	Quadruple-screw G.E.C. turbo-electric
Approximate continuous output	20,000 S.H.P.
Number of G.E.C.-Fraser and Chalmers turbo-alternators	Two
Rated output of each alternator	7,500 kW
Rated output each turbine	10,000 H.P.
Normal speed of sets	3,000 r.p.m.
Number of propelling motors	Four
Approximate continuous output	5,000 B.H.P.
Normal propeller running speed	150 r.p.m.

Boiler Equipment.

Type	High-pressure Babcock and Wilcox water-tube
Number of boilers	Eight
Designed safety-valve blow-off pressure	400 lb. per sq. in.
Designed working pressure at superheater outlet	375 lb. per sq. in.
Superheated steam temperature	650 deg. Fah.
Total generating surface	39,720 sq. ft.
Total superheater surface	17,840 ,,
Total air heater surface	21,120 ,,
Forced draught :	Closed stokehold system, about 2in. water gauge

Auxiliary Generator Sets.

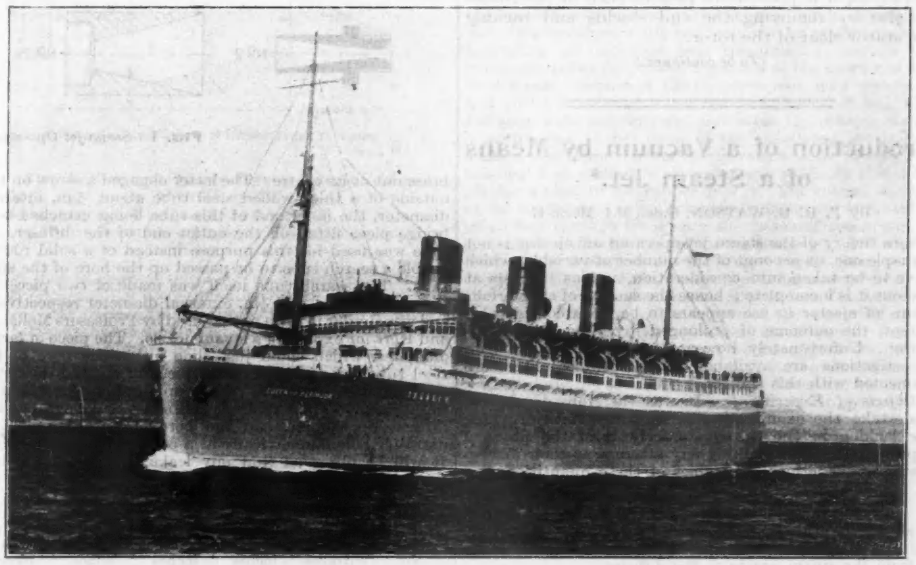
Number of main sets	Four
Type	G.E.C.-Fraser and Chalmers D.C. geared
Rated output each set	750 kW
Rated output each turbine	1,000 H.P.
Speed of turbine	6,000 r.p.m.
Speed of generator	750 r.p.m.
One 50-kW oil engine driven emergency set	

The construction of such a large and important liner as the "Queen of Bermuda" in fifty-three weeks, or a little over a year, is a feat on which the builders must be congratulated, and which has only been made possible by the closest collaboration between Mr. J. M. Ormston, who was in charge of the shipbuilding operations at Barrow-in-Furness ; Mr. E. W. Harvey, the owners' superintendent ; Mr. J. Callander, of Vickers Armstrong's engineering department ; the engineers of the General Electric Company, Ltd., and the many sub-contractors. The keel of the ship was laid on December 5th, 1931, she was ready for launching on September 1st of the following year, and was completed ready for trials early this month—February 7th. As shown above, the ship presents a handsome appearance in the water. Her well-raked stem and cruiser stern, with the widely flared bows for heavy North Atlantic weather, combine, with the high superstructure, the three funnels, and raked masts to give an unusually pleasing impression. The vessel has four complete steel decks, with additional steel decks in the holds at both the forward and after ends ; two almost complete decks in the superstructure, and the usual navigating bridge and houses. The hull has been divided into a large number of water-tight compartments by means of water-tight bulkheads, and the provision of a double bottom, together with a complete double skin up to the water line, ensures the maximum safety at sea. In addition to the usual double-bottom tanks for fuel, oil and fresh water, provision is made for carrying a large quantity of fresh water other than that required on the ship, which is necessary for the company's Bermuda hotels. In all over 2000 tons of fresh water can be carried.

The ship has a very complete equipment of both fire-detection and extinguishing apparatus. The holds are equipped with the Walter Kidde Lux-Rich smoke detection system, which comprises a fourteen-tube cabinet in the wheel-house, working in conjunction with a CO_2 gas extinguishing system. In the boiler-rooms we noted that the Lux bilge flooding system was installed, and that in the machinery spaces Lux hose reels for hand emergency use were provided. More than 500 cabin spaces are equipped with the "Silex" system of fire protection, which consists of a thermostat fitting in each cabin with an electrical indicator on the bridge.

Both in the corridors of the cabin spaces and in the principal public rooms there are a number of Pyrene Phomene hand extinguishers, as well as the usual hydrants and hose fittings for the ship's fire mains. The principal strategic points in the vessel are further protected by fire-resisting doors made of timber, fire-proofed by the Oxylene process. For parts of the ship and machinery in contact with heated surfaces special Bandall insulation is employed, while throughout the passenger accommodation extensive use has been made of Porcella fireproofing composition. These precautions, coupled with the very strict fire patrol in all parts of the vessel, should help to reduce as far as possible any risk of fire. The lifeboat equipment includes both motor-propelled and hand-propelled lifeboats with Fleming gear. The boats are swung on Welin-MacLachlan davits and are carried fully 8ft. above the deck, enabling the boat deck to be utilised as a sun promenade.

Some other features of the hull and machinery equipment we hope to deal with in our second article.



QUEEN OF BERMUDA ON TRIAL IN THE CLYDE ESTUARY

PROPELLING MACHINERY.

The plan and elevation drawings of the machinery lay-out, which we reproduce on the page opposite, show the arrangement of the propelling and auxiliary generator equipment, and particulars of the hull and machinery are given in the accompanying table. The arrangement adopted follows closely that of the sister ship, but, by omitting the lower swimming bath over the auxiliary generator room, a more convenient grouping of these important auxiliaries has been obtained. The steam controls and the turbo-alternator governor mechanism are generally similar to those installed in the "Monarch of Bermuda."

The "Queen of Bermuda" has four propellers, designed to transmit approximately 20,000 total shaft horse-power continuously. Each propeller is separately driven by a synchronous motor of 5000 S.H.P. normal rating at a speed of 150 r.p.m. The four motors are supplied with current at 3000 volts from two 7500 kW G.E.C.-Fraser and Chalmers turbo-alternators, running at 3000 r.p.m. It is possible, by the provision of a simple system of switching, which will be described later, to connect each of the propulsion motors to either of the two turbo-alternators, although, in normal circumstances, the ship functions in a manner similar to a twin-screw vessel, the two port propulsion motors operating in unison either ahead or astern from the port alternator, and the two starboard motors operating in unison ahead or astern from the starboard alternator.

Both turbo-alternators, one of which is shown herewith, are situated in the forward engine-room, between the two boiler-rooms, each set consisting of a Fraser and Chalmers high-pressure, multi-stage impulse turbine coupled to a Witton alternator. The turbines are designed to operate with steam at 350 lb. per square inch pressure and 650 deg. Fah. total temperature, 28in. vacuum, and are specially arranged for low head room, having a broad exhaust casing which takes full advantage of the vacuum and provides adequate attachment for the Weir regenerative condenser, which is bolted on the turbine exhaust flange and supported on springs.

A flexible coupling is employed between the turbine and alternator, and is fitted with internal collars to limit the relative movement of the two rotors when the ship is pitching. Each of the alternators—see page 190—is rated at 7500 kW, 3000 volts, three-phase, 50 cycles, at 3000 r.p.m., and is provided with a closed circuit cooling system having tubular type sea-water coolers. Both alternators are continuously rated and the maximum temperature rise, ascertained by the six temperature indicators embedded in the stator and by resistance measurement in the case of the rotor, is substantially within the limits laid down by British Standard Specifications. Mica and micanite insulation are used throughout the construction, and in order to maintain the insulation in good condition, free from condensation, during the periods when the alternators are not in use, two 1 kW electric heaters are embodied in the frame of each machine.

Excitation is obtained from the 220-volt ship supply generated by the four auxiliary generators. The excitation is, in each case, applied through the medium of a special negative booster of 23 kW capacity, which provides over excitation for starting. Three booster sets are installed, one acting as a reserve.

The four propulsion motors, which are illustrated herewith, are situated aft in the motor-room, the supply from the alternators to each motor being taken through special cables.

The design of these Pirelli-General propulsion cables has received careful consideration. Two factors were borne in mind ; first, the confined space in which the cables had to be installed, and secondly, the ambient temperature in which they would be called upon to function. It was finally decided that, instead of using one group of very large conductor single-core cables per motor, a number of three-core cables in parallel should be employed, which would be easier to handle in position than the big single-core type. The actual cable installed consists of three tinned copper conductors of 0·45 square inch cross section, insulated with varnished cambric for the full voltage of the supply to earth, namely, 3300 volts, each core being braided and each phase indicated by colour, the cores wormed circular, lead-sheathed, and braided overall, and finally impregnated with fireproof compound.

These cables are installed in groups of three, two groups on the starboard side and two on the port side. Great care was required in the installation owing to the restricted route. In passing through water-tight bulkheads, non-ferrous metal packing glands are employed to ensure proper water-tight protection between one compartment and the other. The ends of the cables themselves are taken to terminal boxes, mounted on the motors and in the control switch cubicles, the fixing formation being two groups of three, placed one in front of the other, and supported by means of hard-wood cleats fixed to the ship's structure.

Each propulsion motor is of the totally enclosed, three-phase, salient pole synchronous type, provided with heavy damping windings in the pole faces, to develop the high torque required during the reversing of the ship. They each develop approximately 5000 H.P. at 150 r.p.m. The motors are exceptionally light, a feature obtained by the use of completely fabricated stator and end shields. The shaft of each motor is of heavy construction and is supported at each end by bearings mounted on the end shields.

A disc form of lubrication has been adopted which, it is claimed, possesses many advantages for a machine operating over a very wide range of speeds, and in particular for running for long periods at very slow speeds. A large disc is fitted to the outboard end of the shaft, just inside the bearing housing. The disc revolves in the oil, which is brought up to the top of the disc at every revolution. The oil is taken off the disc at the top by means of a metal scraper, and is fed into a trough. It then passes on to the top of the shaft at the centre of the bearing, from which it is distributed along the whole length of the bearing surface, returning by gravity to the oil well. A separate completely enclosed system of ventilation is installed for each motor, and comprises a motor-driven fan and tubular sea-water cooler, together with the necessary trunking. The insulation throughout is specially designed to withstand possible corrosion by sea air and the moist heat of tropical climates. In particular, the rotor is insulated to withstand the high induced voltages occurring during the reversing of the ship, and, as in the case of the alternators, electric heaters are inserted to maintain the windings at an even temperature when the ship is in port.

By means of the particular form of construction employed, it is possible to inspect each of the rotors on site by removing the end shields and racking the stator clear of the rotor.

(To be continued.)

Production of a Vacuum by Means of a Steam Jet.*

By F. R. B. WATSON, B.Sc., M.I. Mech. E.

THE theory of the steam jet-operated air ejector is not a simple one, on account of the number of variables which have to be taken into consideration, and as it exists at present it is incomplete; hence the success of the various forms of ejector in use appears to be, to a considerable extent, the outcome of prolonged experimental investigation. Unfortunately, however, very few results of such investigations are available in the technical literature connected with this subject.

Objects of Experiments.—It was therefore decided to undertake the examination of certain quantities which are lacking in the theory, entirely from the physical aspect and without making any attempt at their mathematical elucidation. The chief of these quantities were as follows:—

(1) One important length, which is not included at all in the theory, and which has a very important influence on the vacuum produced, namely, the distance from the steam nozzle to the diffuser.

(2) The reason why better results are obtained from an ejector in which the diffuser has a long parallel throat. In the theory, consideration is given only to the case of a gradual constriction tapering off to the outlet, without having any length parallel.

(3) How the improvement in vacuum effected by having this parallel throat can be explained physically.

Other objects of a more practical nature were:—

(i) The determination of the ratio of steam to air at different vacua and under different initial steam pressures.

(ii) Observations of the rise of pressure of the combined stream of steam and air as it passed through the diffuser.

(iii) Comparative results for the ejector working with a diffuser having a short rounded entrance compared with one having a tapered entrance, the latter being the more usual form in practice.

For information on sections (1), (2), and (3) it was found necessary to carry out a careful inspection of the steam jet to observe the changes in the stationary waves in the core of the jet under different initial steam pressures and under different outlet pressure conditions. An optical method of inspection was adopted, for this caused no disturbance of the jet, and photographic records were obtained. The author considers that these photographs may be of some interest in connection with the discharge from steam nozzles in general, as they show certain changes in the jet produced by changes of outlet pressure.

Description of Apparatus.—The ejector used was a single-stage one (which would, of course, correspond to a second stage unit in a two-stage ejector), and it was originally designed to extract 35 lb. of dry air per hour, the air being supposed to be saturated with water vapour at 61 deg. Fah., with a steam consumption of 230 lb. per hour of initially dry and saturated steam at 100 lb. per square inch by gauge, while maintaining a vacuum of 25·5in. of mercury. It was afterwards realised that this project was a somewhat ambitious one. The above figures give a steam-air ratio of 6·6, and whether this performance is physically possible or not with an apparatus of this kind under the assumed conditions, the author is unable to state with certainty; but the actual performance never approached so low a figure, and the ejector had to be operated at a higher steam pressure to give the required vacuum. (This weight of air would be the allowance, by the British Electrical and Allied Manufacturers' Association rating, for a land surface condensing plant condensing 64,000 lb. of steam per hour.) All the experiments recorded here were carried out with atmospheric air only, and no attempt was made to use saturated air.

In the course of these experiments two ejectors were used. The first one which was designed gave fairly good results from which much useful information was obtained. But there was a screwed connection between the air chamber and the diffuser, and although different settings of the diffuser in relation to the steam nozzle could be made by using loose collars or distance pieces, it took too long to effect the required alterations. Hence a second ejector with a sliding diffuser, shown in section in Fig. 1, was designed by the author, in which the diffuser could be moved along horizontally while the ejector was operating, thus enabling the vacuum at any diffuser setting to be rapidly obtained.

This movement was effected by rotating the hand wheel (shown in Fig. 1) which was mounted on a long brass nut at its centre. The latter engaged a screw on the outside of a thick-walled steel tube about $\frac{5}{16}$in. internal diameter, the inner end of this tube being attached to a bridge piece fitted on the outlet end of the diffuser. A tube was used for this purpose instead of a solid rod to enable a search tube to be passed up the bore of the steel tube. The search tube itself was made of two pieces of brass tube, $\frac{1}{8}$in. and $\frac{1}{4}$in. external diameter respectively, and was similar in form to that used by Professors Mellanby and Kerr for exploring a steam nozzle. The piece of larger diameter, which could just slide inside the bore of the steel tube, was jointed to the piece of smaller diameter, and the latter could be passed up through the throat of the diffuser. The exploring end of the smaller tube was formed by stopping up the bore and drilling a $\frac{1}{32}$in. diameter hole diametrically at a point $\frac{1}{16}$in. from the end. It will be observed that any leakage which took place through the bore of the steel tube was outwards, as the inner end of this tube terminated in a region where the pressure was slightly above that of the atmosphere, and there was therefore no risk of any leakage through this tube affecting the vacuum. The diffuser could be moved along a considerable distance inside the 2$\frac{1}{4}$in. internal diameter brass cylinder, the clearance between it and the walls being from 0·003in. to 0·004in., and the design adopted also enabled different forms and lengths of diffuser to be used which could be quickly changed. The packing in the sliding diffuser consisted of two coils of thin cotton rope wound in each of two grooves $\frac{1}{16}$in. deep in the tail piece, with the addition of several small grooves $\frac{1}{16}$in. deep turned in the surface, as shown in Fig. 1. The diffuser was made in two parts, screwed together, and they could come apart on a transverse plane passing through the outlet end of the throat. When the same diameter of throat was used, inlet ends with different throat lengths or inlet ends with different forms of entrance could be used on the same tail piece. The throat diameter of the four diffusers used in these experiments was $\frac{3}{4}$in., and the two lengths of throat used were (*a*) nearly $\frac{1}{16}$in., *i.e.*, with practically no parallel portion in the throat, and (*b*) 1$\frac{1}{2}$in., *i.e.*, with a length of parallel throat equal to twice its diameter. The two forms of entrance used were (i) a short rounded form having a length up to the throat (including the throat of negligible length) of 1in., and (ii) a straight tapered form having a length up to the throat of 3in. The particulars and reference numbers of the four diffusers and the two steam nozzles used are given in Tables I. and II.

In the experiments on both designs the ejector in use was connected to one of the openings in a steam separator about 9in. internal diameter and 27in. deep, and the steam pressure at the nozzle inlet was varied by throttling the steam at a stop valve on the admission pipe to the separator. The general arrangement of the testing plant is shown diagrammatically in Fig. 2. The maximum steam pressure available was 140 lb. per square inch by gauge, and the superheat at the separator varied from about 5 deg. Fah. to 20 deg. Fah., according to the rate of discharge by the nozzle. The separator and steam pipe were well lagged. The cylindrical air tank, of about 2·5 cubic feet capacity, into which air was allowed to leak and in which the partial vacuum was maintained, was situated vertically below the air inlet to the ejector and connected to the latter by a 1$\frac{1}{4}$in. diameter pipe fitted with a stop valve at its connection to the air inlet. This valve could be closed, along with the air leak, and the tank allowed to stand for a time under partial vacuum, to test the joints on the tank for air-tightness. A supplementary air inlet to the ejector (shown at R in Fig. 1) was provided, but no improvement in the vacuum was effected when this was put in communication with the air tank while the ejector was operating. The air leaking into the tank flowed through two orifices, 9$\frac{1}{2}$in. apart, the outer one being $\frac{1}{4}$in. diameter and sharp-edged and the inner one $\frac{1}{8}$in. diameter, and they were mounted on an air box connected to the side of the tank. The pressure difference across the outer orifice was measured by means of an inclined water gauge. The steam and air on leaving the ejector passed into a small surface condenser where the steam was condensed at atmospheric pressure, and collected and weighed if necessary.

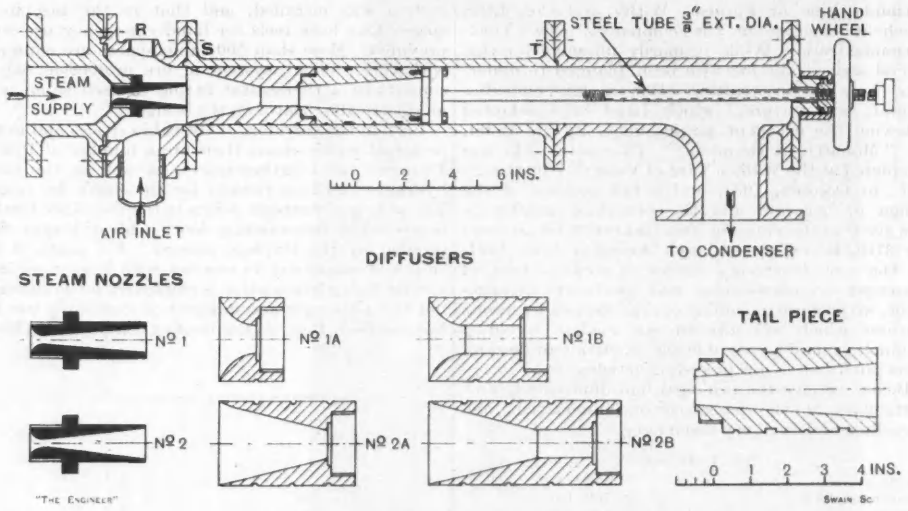


FIG. 1—*Steam-jet Operated Air Ejector, with Sliding Diffuser.*

TABLE I.—*Particulars of Diffusers.*

Diffuser No.	Form of entrance.	Length of entrance, inches.	Diameter of throat, inches.	Length of throat, inches.	Length of tail piece, inches.
1A	Rounded	1	$\frac{3}{4}$	Nearly $\frac{1}{16}$	5
1B	,,	1		$1\frac{1}{2}$	
2A	Tapered	3		Nearly $\frac{1}{16}$	
2B	,,	3		$1\frac{1}{2}$	

TABLE II.—*Particulars of Steam Nozzles.*

Nozzle No.	Diameter of throat, inches.	Diameter of outlet, inches.	Length from throat to outlet, inches.	Cone angle, deg.	Vacuum* at discharge, inches of mercury.
1	$\frac{7}{32}+0·0005$	$\frac{11}{16}$	$2\frac{13}{16}$	9·5	25·5
2	$\frac{7}{32}+0·008$	$\frac{7}{8}$		13·1	27·2

* The vacua given in this table are those for which the nozzles were designed when the admission pressure was 100 lb. per square inch by gauge; when the admission pressure was 140 lb. per square inch by gauge the vacua for which the nozzles were suited were 24·0in. and 26·25in. respectively.

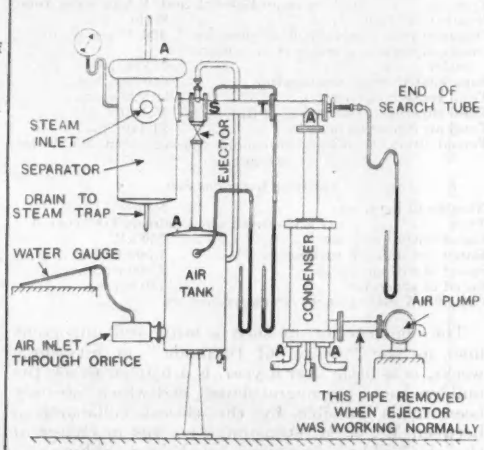


FIG. 2—*Diagram Showing General Arrangement of Plant.*
A. Thermometer pockets.

SURVEY OF RESULTS.

All vacua were measured by mercury columns, three of which were used, one on each of the following parts: air tank, air chamber (used during photographic work), and search tube. All vacua have been reduced to the equivalent of 30in. barometric pressure. All steam pressures given are by gauge, unless otherwise stated.

The Lengths L and D.—When the diffuser of an ejector is moved relatively to the steam nozzle two quantities which affect the vacuum are altered, namely, the length from the outlet end of the nozzle to the inlet of the diffuser, and the length from the outlet end of the nozzle to the entrance of the throat of the diffuser. These two lengths will be referred to as L and D respectively. In the former case the circumferential area of the jet in contact with the entering air is altered, and in the latter the setting of the diffuser throat with reference to certain wave sections in the series of stationary waves in the core of the jet. The stationary waves referred to here are caused by a sudden change of pressure. It is rather difficult to say with certainty how the air is entrained by the steam jet in an air ejector, and some writers on the subject are inclined

* The Institution of Mechanical Engineers.—Abstract.

to attach chief importance to the effect of surface friction. This varies with L, but from the results recorded here it will be seen that, with this type of ejector the predominating quantity in producing the high vacua is apparently the value assigned to D. But it is probable that these two lengths are connected respectively with two entirely different functions which the ejector has to perform, the first the admission and entrainment of the air, and the second a sealing or partial sealing of the diffuser throat (by a portion of a wave in the jet) as well as a pumping action between the regions of low and high pressure. Of course, in a particular case when once the correct value of D has been obtained, it is possible that a further slight improvement in vacuum may be effected by an adjustment of L. In the experiments recorded in this paper with the sliding diffuser L and D were changed simultaneously, the diffuser being moved inwards towards the steam nozzle in all cases, and it will be observed from Figs. 3 and 4 that while L was being decreased the vacuum was increased up to a certain point, which indicated that the length D was the predominant one.

Over-expansion of the Steam Leaving the Nozzle.—When steam, after entering a nozzle at a certain initial pressure, expands and issues at the exit section with a pressure equal to that of the external medium, it is completely expanded. This outlet condition has been referred to in this paper as discharge at the "designed pressure," *i.e.*, the outlet pressure for which the nozzle was designed. When the pressure outside the exit section of the nozzle is greater than the designed pressure "over-expansion" of the steam is said to take place in the nozzle, and when it is less "under-expansion" is said to take place in the nozzle. It is sometimes stated that over-expansion is an effect which contributes to the production of a good and steady vacuum in an air ejector, and the author's experience on the whole bears this out, and also showed that the over-expanded jet was better suited to the conditions over the wide range of pressure used. Hence in all the tests recorded in the paper with air flow conditions the steam jet was in an over-expanded state, and nozzle No. 2 was used. The additional suction effect produced by over-expansion would appear to be produced by the inward pressure of the surrounding air on the steam jet (of lower pressure) and in the process the air becomes more deeply embedded in the jet, and the waves, of course, are more pronounced. It is important to remember that an improvement in vacuum due to any cause, such as a favourable diffuser setting, would be accompanied by a slightly increased jet velocity due to the increased heat drop, and hence the effect on the vacuum would be cumulative.

Variation in Vacuum with D.—In Figs. 3 and 4 are shown the variations in vacuum for different values of D for diffusers Nos. 1 and 2 with $\frac{1}{16}$in. and 1$\frac{1}{2}$in. throat in each case, and these observations were carried out at as nearly as possible constant steam pressures of 80 lb., 100 lb., 120 lb., and 140 lb. per square inch by throttling the steam at admission to the separator. These curves show, in the first place, that the lower steam pressures would not produce a high vacuum when air flow took place through the tank. For the ejector to work satisfactorily the velocity of the issuing steam must be high, but with both a low vacuum and a low initial steam pressure the heat drop across the nozzle is low, and consequently the steam velocity is relatively low. The second point to be noticed in these curves is that the lower the pressure the lower is the value of D for maximum vacuum at that pressure, *e.g.*, in Fig. 3 the point A moves towards the left as the pressure is reduced. The explanation of this result was evident from the photographic records of the jet, which showed clearly the shortening of the wave series in the jet with reduced pressure drop across the nozzle.

The curves in Figs. 3 and 4 afford a means of comparing the advantages or otherwise of the two different forms of entrance to the diffuser. Diffuser No. 2, with the tapered entrance, appears to be on the whole the better form, for it gave a slightly higher vacuum over a greater range, and when in use it was more stable in its action. These advantages probably account for this form of entrance being adopted by so many makers of air ejectors. A peculiarity in the behaviour of diffuser No. 1 was the sudden and rapid rise of vacuum at practically constant pressure at certain diffuser settings, when the steam pressure was slowly increased. The mercury almost rushed up the tubes of the gauges. With diffuser No. 2 the mercury rose much more slowly—sometimes just moving—when the diffuser occupied positions corresponding to those referred to above. The same tail piece was used on all the diffusers when the observations plotted in Figs. 3 and 4 were made.

Effect of the Long Parallel Throat.—It has already been stated that in most air ejectors the diffuser has a throat which is parallel for a considerable length, and the reason for this may be seen from a study of the curves in Figs. 3 and 4, in pairs at the same steam pressure, for at practically every pressure shown, with both types of diffuser, the one with the parallel throat gave the higher maximum value for the vacuum. The advantage is also clearly shown by comparing the two groups of vacuum pressure curves, with air flow, in Fig. 5, where the full-line curves show higher vacua than the dotted curves. It will be observed in Figs. 3 and 4 that, especially at the higher pressures of 120 lb. and 140 lb. per square inch, the throat tends to give a more nearly uniform vacuum over the range shown; this is due to the formation of a second "peak" on the curves. In Fig. 4 at a pressure of 140 lb. per square inch the same vacuum (25·2in.) is reached at two positions of the diffuser, namely, when D=3$\frac{1}{2}$in. and when D=1$\frac{1}{2}$in., and it is interesting to note how the vacuum is produced as the pressure rises in the two cases. This is shown in Fig. 6 by the two curves marked M and N, and it is seen that the inner position (D=1$\frac{1}{2}$in.) is evidently the better setting. This is rather an important result to be observed in the design of an ejector.

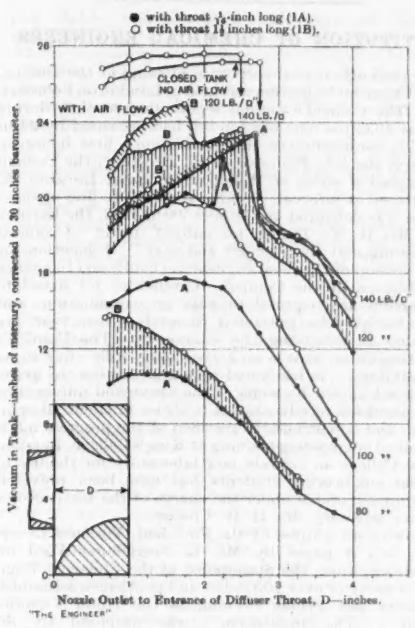


FIG. 3—*Vacua at Different Diffuser Settings, Diffusers Nos.* 1A *and* 1B.

Constant steam pressures: 80 lb., 100 lb., 120 lb., and 140 lb. per square inch gauge. Steam Nozzle No. 2.

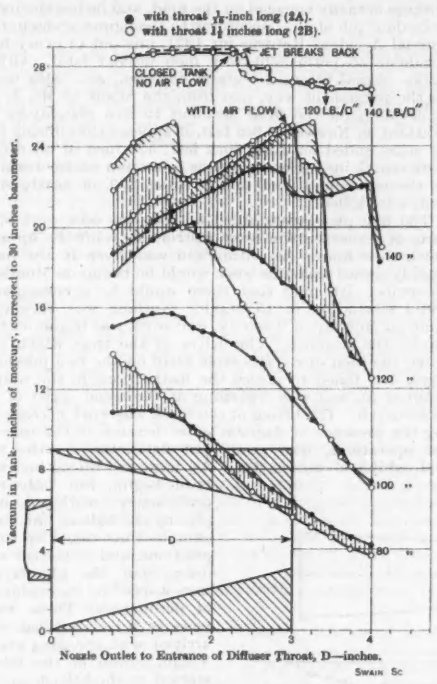


FIG. 4—*Vacua at Different Diffuser Settings, Diffusers Nos.* 2A *and* 2B.

Constant steam pressures: 80 lb., 100 lb., 120 lb., and 140 lb. per square inch gauge. Steam Nozzle No. 2.

Increase of Vacuum with Initial Steam Pressure.—As an air ejector of this kind depends for its action on the velocity of the issuing steam, a vacuum pressure curve should be somewhat similar in form to a velocity pressure curve. The curves showing the growth of vacuum with the increase of steam pressure for diffusers Nos. 1 and 2 are given in Figs. 5 and 6 for about the best diffuser settings at 100 lb., 120 lb., and 140 lb. per square inch, the settings used having been taken from the curves in Figs. 3 and 4. The vacua reached with closed tank and "no air flow" are also shown.

The curves in dotted lines in Fig. 5 are for the diffuser with practically no length of parallel throat, and it will be seen that in addition to the maximum values of the vacuum being low compared with those for the diffuser with the 1$\frac{1}{2}$in. parallel throat, the slopes of the curves are less steep. One of the essentials of a good air ejector is that the vacuum pressure curve should be steep, *i.e.*, that the vacuum required should be reached at as low a steam pressure as possible. This is evidently the most economical result, for the higher the pressure for any given vacuum the greater will be the weight of steam discharged from the nozzle and the higher the steam/air ratio.

Performance of this Ejector.—In considering the performance of this apparatus it should be borne in mind that it was of very simple design and intended primarily for the examination of certain problems; therefore all its parts had to be readily accessible for changing quickly. The steam collected was less than the true amount of steam used, as the steam entering the condenser was carrying over with it all the air entrained, and therefore much vapour was carried off with the air leaving the condenser. (Hence there must be a liberal allowance of cooling surface in the intercondenser of a two-stage ejector, for the weight of steam condensed.) The percentage of missing steam at any one admission pressure appeared to vary considerably. Several measurements were made at a pressure of 120 lb. per square inch on different days and results giving as high a figure as 25 per cent. were obtained. If the air inlet to the ejector was suddenly closed, the outlet circulating water temperature would suddenly rise by several degrees, indicating an improved heat transmission through the condenser tubes due to the exclusion of the entrained air. At a steam pressure of 120 lb. per square inch with inlet and outlet circulating water temperatures of 58 deg. and 102 deg. Fah. respectively, and when the missing steam quantity was 15 per cent. of the calculated nozzle discharge, the outlet water temperature rose rapidly by 6·5 deg. Fah. when the air orifice was suddenly closed by placing a piece of flat rubber over it. The cooling surface in the condenser was approximately 28 square feet. With no air flow through the ejector the measured steam was in good agreement with the calculated discharge. The superheat of the steam in the separator varied from about 5 deg. to 20 deg. Fah., hence the average superheat of 10 deg. Fah. has been assumed at all pressures in calculating the nozzle discharge. The curves of the steam/air ratio for the three higher pressures used are shown in Figs. 5 and 6. The best performance, which approached most nearly the somewhat ambitious conditions assumed in the original design, was evidently with diffuser No. 1B, when a vacuum of 23·7in. was maintained at 115 lb. per square inch when exhausting 27·5 lb. per hour of atmospheric air, the steam consumption being 277 lb. per hour; these figures give a steam/air ratio of practically 10. For diffuser No. 2B at 120 lb. per square inch the vacuum was 24·9in., the steam consumption and air extracted 288 lb. and 27·7 lb. per hour respectively, and the steam/air ratio 10·4.

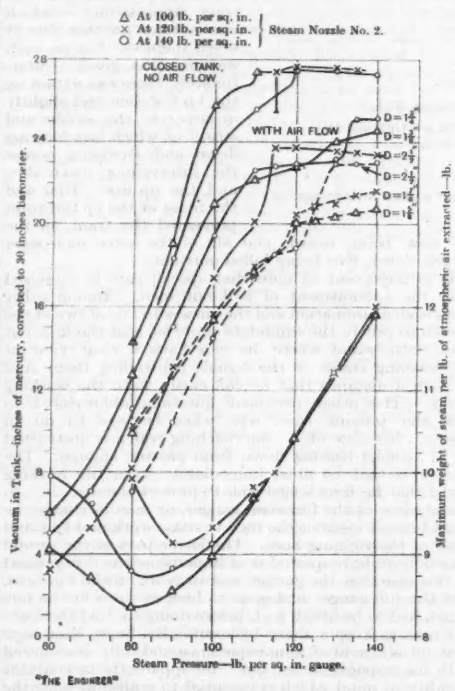

△ At 100 lb. per sq. in.
× At 120 lb. per sq. in.
○ At 140 lb. per sq. in.
Steam Nozzle No. 2.
CLOSED TANK, NO AIR FLOW
WITH AIR FLOW
D=1$\frac{1}{16}$
D=1$\frac{1}{2}$
D=2$\frac{1}{2}$
D=2$\frac{1}{2}$
D=1$\frac{1}{16}$
D=1$\frac{1}{2}$
Vacuum in Tank—inches of mercury, corrected to 30 inches barometer.
Maximum weight of steam per lb. of atmospheric air extracted—lb.
Steam Pressure—lb. per sq. in. gauge.
"THE ENGINEER"

FIG. 5—*Vacuum Pressure Curves for About Best Setting of Diffuser at* 100 *lb.,* 120 *lb., and* 140 *lb. per Square Inch.*

– – – Diffuser 1A (throat $\frac{1}{16}$in. long).
—— Diffuser 1B (throat 1$\frac{1}{2}$in. long).

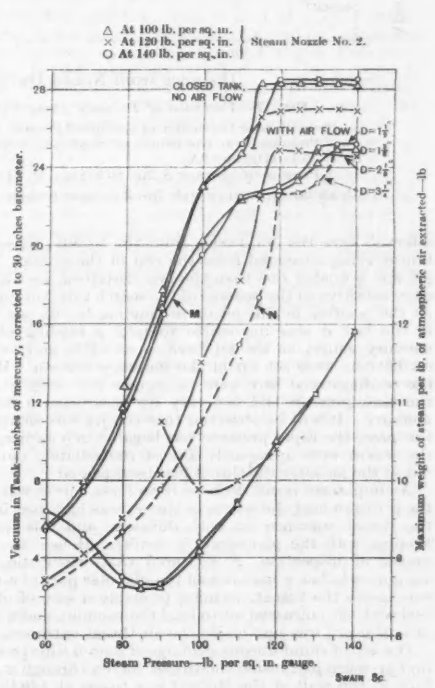

△ At 100 lb. per sq. in.
× At 120 lb. per sq. in.
○ At 140 lb. per sq. in.
Steam Nozzle No. 2.
CLOSED TANK, NO AIR FLOW
WITH AIR FLOW
D=1$\frac{1}{16}$
D=1$\frac{1}{2}$
D=2$\frac{1}{2}$
D=3$\frac{1}{2}$
M
N
Vacuum in Tank—inches of mercury, corrected to 30 inches barometer.
Maximum weight of steam per lb. of atmospheric air extracted—lb.
Steam Pressure—lb. per sq. in. gauge.
SWAIN Sc

FIG. 6—*Vacuum Pressure Curves for About Best Setting of Diffuser at* 100 *lb.,* 120 *lb., and* 140 *lb. per Square Inch.*

Diffuser 2B (throat 1$\frac{1}{2}$in. long).

INSPECTION OF THE STEAM JET.

Methods Adopted.—It appeared probable that the stationary waves in the core of the steam jet were responsible for the great changes which took place in the vacuum, and it was resolved to examine these waves and to photo-

graph them if possible. In order to do this the principle of the "ultra" microscope was applied, *i.e.*, rays from a source of light were allowed to pass through a narrow slit and thereby illuminate the plane section of the jet to be viewed or photographed, either operation being carried out in darkness, so that the only light rays reaching the eye or the camera lens were those from the particles on the illuminated section.*

Variation of Pressure Along the Diffuser by Search Tube.—The rise of pressure along the jet from the outlet of the steam nozzle to the outlet of the diffuser is shown by the full-line curve in Fig. 7, and diffuser No. 2B was used in taking these observations. The jet with this diffuser was remarkably free from any disturbance when the ¼in. search tube was passed up its centre, and confirmation of this can be seen in the tank pressure curve, which is practically horizontal except for one marked disturbance in the neighbourhood of the point marked G. The pressures were measured at ¼in. intervals for a distance of 7in. from the nozzle, and at larger intervals for the remaining 2½in. They were quite steady except at a few points, where, however, the oscillation of the mercury column did not exceed ¼in. at the most. This curve shows the waves remarkably clearly, and the probable form of the jet, for 4in. of its length, has been sketched freehand on the diagram, projections having been taken from the crests and troughs of the waves, except at the point G. It will be observed that vigorous waves penetrated the parallel throat and their wave-length was well maintained, this being quite in agreement with the photographic results. The wave-length was rapidly reduced, indicating most probably a rapidly reduced velocity, as the jet emerged from the throat into the diverging tail piece, where the pressure rise was rapid with the rapidly diminishing kinetic energy.

The dotted curve in Fig. 7 is for the jet passing through diffuser No. 2A, with ½in. length of throat, with the same steam pressure as in the last case, namely, 140 lb. per square inch, and the readings used were taken at ¼in.

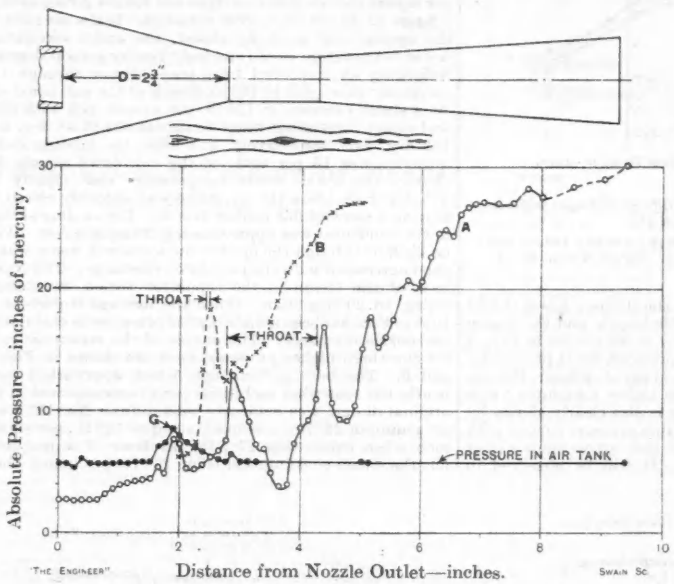


FIG. 7—*Variation of Pressure Along Diffuser by Search Tube.*

A. Pressure near the centre of combined stream, by search tube (Diffuser 2B).
B. Pressure near the centre of combined stream, by search tube (Diffuser 2A). Pressure in air tank 8·2in. to 8·8in.; D, 2¾in.

With air flow; steam nozzle No. 2; steam pressure, 140 lb. per square inch gauge.

intervals over the 3in. range, from 2in. to 5in., these distances being measured from the end of the nozzle. This jet was a weaker one than the last described, and it was more sensitive to the passage of the search tube through it. At the position in this jet corresponding to the one at G in the last it was impossible to take a reading of the mercury gauge, as the jet became unstable and violent oscillations were set up in the mercury column. While the readings used here were taken over the range stated, the tank pressure did not vary by more than 0·6in. of mercury. It will be observed that the jet was shorter in this case, the rapid pressure rise began much earlier, and the waves were apparently almost immediately damped out of the jet after the throat had been passed.

An important result deduced from these curves was that the pressure near the centre of the jet was high just inside the throat entrance for both diffusers, and this was in keeping with the photographic results. Hence, by both means of inspection, it appeared that when the high vacuum was being maintained the globular part of a wave was inside the throat, forming probably a sort of elastic seal with the entrained air to hold the vacuum, and a neck, or anti-node, was just inside the air throat entrance.

One set of simultaneous readings of search tube pressure and pressure just inside the throat (taken through a $\frac{1}{32}$in. hole in the wall of the throat) was taken at 140 lb. per square inch steam pressure with diffuser 2B, by traversing the diffuser and search tube together over a distance of 2in. from D=4·5in. to D=2·5in., and this range included the diffuser setting where the sudden rise of vacuum took place. The hole in the tube was kept at the same cross section as the hole in the wall throughout this movement. For the first ¾in. of this distance the tube pressure was higher than the wall pressure, and for the next ⅞in. the reverse was the case. When the sudden rise of vacuum took place the wall pressure suddenly dropped to a pressure which was nearly 2½in. of mercury below the tube pressure. This indicated that the pressure round the anti-node in the throat entrance was lower than the pressure near the centre of the jet at this section.

* The photographs obtained and the author's comments on them are here omitted.—ED. THE E.

Accidents to Platelayers.

THE platelayer, whose century-old very descriptive title the railway authorities would change to the non-descript name of underman, deserves the respect, gratitude and sympathy of all concerned or interested in railways. He fills a useful place in the upkeep and safety of the permanent way, and is the handy man of nearly all departments. In railway service his grade is the most numerous of those actually engaged on the road, and he has the most hazardous job of all. According to the figures given in the Annual Accident Returns for 1931, one out of every five accidents to permanent way men proved fatal. Other ranks—signal fitters, telegraph wiremen, &c.—also work on the permanent way, and from the report of Mr. J. P. Scott Main on the fatal accident to five platelayers at Watford on November 9th last, it appears that during the 4½ years ended on June 30th last, 470 men of all ranks were struck by engines or trains in motion whilst working on the permanent way, and of these, 233, or nearly one-half, were killed.

The five platelayers killed at Watford were part of a gang of seventeen who were instructed to lift the up and down slow lines. An intimation was given in the fortnightly notice that this work would be begun on Monday, November 7th, and that there would be a consequent speed restriction to 15 m.p.h. Nothing was, however, done on Monday or Tuesday, and work was begun on the day of the accident. The driver of the train which ran down the men drove the same train on the two previous days, and failed to notice the instructions in the notice referred to, and was travelling at the usual speed of 40 to 45 m.p.h. The lifting of the track was work necessitating the presence of flagmen some distance in the rear of the operations, who would put detonators on the rail and exhibit a caution flag. As, however, lifting had not been begun, but only the preliminary work of displacing the ballast, the flagmen had not taken up their positions, and so neither the driver nor the platelayers were warned by the explosion of detonators. There was, however, a look-out man who arrived with the gang about 9 a.m. Seven of the latter started on the ballast on the up slow line and the look-out man stood opposite to them, watching the line to the limit of his observation—a distance of some 670 yards. Seeing the signal at Watford Station lowered for a train on the up slow, he gave a warning by means of four whistles, which is the code for the up slow line, and by word of mouth. Nevertheless, a number of the men continued at work under the impression that they would get another warning when the look-out man saw the train approaching — which was not for another five or seven minutes—but no such warning was given. Unfortunately, there was a train on the up fast line and slightly in advance, the smoke and steam of which was blowing down and sweeping across the intervening down slow and the up line. That and the noise of the up fast train prevented the train on the up slow being heard, and six of the seven men were struck down, five being killed outright.

It is important to note that special care is exercised over the appointment of look-out men. Among other tests is an examination and the answer to one of two of the questions put to the candidate provides that the look-out man must stand where he can have a clear view of approaching trains or the signals controlling them, and at such a distance that he can easily warn the working party. The other pertinent question, abbreviated to suit the present case, was what he was to do in case . . . his view of . . . approaching trains is obstructed by . . . smoke beating down from passing engines. The answer is that he must immediately warn the working party that he is no longer able to protect them. . . . In the absence of the foreman, ganger, or man in charge, he must himself instruct the men to cease work and to stand clear of the running lines. The latter part of the second question we have quoted is of importance, as it happened in this case that the ganger was away on official business, and the sub-ganger had gone to look at some of the line which had to be lifted, and, before doing so, told the look-out man to keep a sharp look-out. Mr. Scott Main says that he is a man of long experience and fully acquainted with his responsibilities, but "he apparently lacked that rapidity of mind which is essential to realise at once the risks of such a situation and act accordingly."

In the forefront of the comments made by Mr. Scott Main is the expression of his opinion that the preliminary warning should be a verbal one, and that the intimation to stand clear be given by whistle. After recommending that the railway company should consider the desirability of posting flagmen before the commencement of operations which entail speed restrictions, the 470 accidents mentioned above are referred to, and it appears that 77·5 per cent. of them were investigated by the assistant inspecting officers. The policy, Mr. Main says, has been to inculcate, by education, sound judgment in those in immediate charge, so that they may be able properly to estimate and provide for the various conditions which have to be taken into account. On the subject of mechanical or electrical means of warning, it is observed that the Railway Employment Safety Appliances Committee has examined appliances of that character, but with indifferent results. Generally, it is felt that the disadvantages outweigh the advantages, and that for the protection of men engaged upon the permanent way the services of properly qualified look-out men are to be preferred.

The report concludes with the recommendation that representatives of the companies and of the men should discuss nine points which appear to merit consideration, and then observes that in this occupation, as in others, while every precaution may be taken for the prevention of such regrettable accidents, the hard fact must be faced that there is always liability to human failure on the part of a look-out man as well as on the part of individuals.

INSTITUTION OF CHEMICAL ENGINEERS.

THE eleventh annual corporate meeting of the Institution of Chemical Engineers was held in London on February 17th. The Council's annual report showed that during the year 1932 the membership roll had increased by 26 to 726. To commemorate the Institution's first honorary secretary, the late Professor J. W. Hinchley, the Council inaugurated a series of Hinchley Memorial Lectures, to be delivered at intervals of three years. The first of these lectures was delivered on October 28th, 1932, the lecturer being Mr. H. T. Tizard, his subject being "Chemical Engineering and the Aircraft Industry." Education for the profession of chemical engineering continued to engage the attention of the Council. Candidates for associate membership are required to pass an examination, and of the twelve who presented themselves last year, six succeeded in satisfying the examiners. The Council's Education Committee is an active body, fully alive to its responsibilities. It has noted with gratification the growing interest shown by some of the provincial universities in the provision of educational facilities in chemical engineering, and is particularly gratified at the progress made in chemical engineering training at King's College, London. At that College an entirely new laboratory for the use of chemical engineering students has now been provided and equipped, and is under the charge of the Institution's honorary secretary, Mr. H. W. Cremer.

Following an address by the President, Viscount Leverhulme, and a paper by Mr. L. Singlehurst-Ward on "Metallurgy from the Standpoint of the Chemical Engineer," a party of over 200 ladies and gentlemen assembled for dinner last Friday evening at the Hotel Victoria, London. "The Institution" was proposed by Sir Frederick Gowland Hopkins, President of the Royal Society, and was responded to by Lord Leverhulme. Dr. Herbert Levenstein gave the toast of "Our Guests," to which Dr. A. C. Seward (Master of Downing College, Cambridge), Professor H. E. Armstrong (President of the Institute of Fuel), and Dr. R. H. Pickard (President of the Society of Chemical Industry) replied. The speeches were concluded by the toast of "The President," proposed by Mr. W. A. S. Calder, Past-president, and suitably acknowledged from the chair.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

BAYONET LAMP AND LAMPHOLDERS.

No. 52—1933. The first British Standard Specification for bayonet lamp-caps and holders was issued in 1910, and this specification was revised in 1927. The original specification laid down standard dimensions for the holder in such detail that the design of almost every component part was rigidly standardised. Experience showed that this restriction in the design was a serious handicap to the industry, and the specification was, to a large extent, ignored as regards many of its details. Consequently, when the specification was revised in 1927, the only dimensions standardised were those essential to secure interchangeability and adequate mechanical strength. The specification has now once again been revised, and its scope has been considerably increased. It now covers the small size of cap and holder, as well as the "ordinary size," and also includes full details of suitable gauges for rapidly checking the caps and holders for compliance with the specification. Some important changes have been made to the details of the "ordinary-size" holder, in that a slightly lighter gauge of metal may now be used for the non-screwed portion of the barrel of the holder (thus removing the complaint that B.S. holders were unduly heavy and expensive). A new feature is the introduction of minimum mechanical and electrical clearances. The dimensions of lampholder plugs (adaptors) are also dealt with for the first time.

LIGHT ALUMINIUM ALLOY BARS.

Nos. 477 and 478—1933. For some years the light alloy industry has been familiar with the specifications Nos. 3 L. 1 and 2 L. 25 for wrought bars in the two alloys generally known as duralumin and Y alloy. These two specifications were prepared having regard to the use of these materials for aircraft purposes. The present specifications deal with the quality and properties of these alloy bars for general engineering purposes. They detail the compositions of the alloys and their mechanical properties, and include clauses relating to the provision of test samples and the form of test pieces. Dimensions and tolerances are standardised, whilst in an appendix to each specification are given some notes relating to the preparation and heat treatment of the respective alloys. The specification for duralumin covers the requirements of the machinist, and also of the drop forger, and provides for the material as used largely in the automobile industry and for the heavier forms of transport, such as railways, vans and steamships. The Y alloy specifications cover a material used for those parts of internal combustion engines that are exposed to elevated temperatures in service.

Railway and Road Matters.

IT is stated that another 410 B.H.P. oil-electric rail-car, similar to the "Flying Hamburger," is under construction for the Cologne-Essen service of the German State Railway, but the maximum operating speed will not exceed 100 kiloms. per hour.

WE are informed that five hundred of the 1250 new freight train wagons of the latest type which are to be constructed by the G.W.R. will be equipped with the automatic vacuum brake, thus enabling trains of them to be run at passenger train speeds.

THE fatal accident to a gang of platelayers at Watford, L.M.S., on November 9th, was, as one of the more serious accidents to railway servants, inquired into on behalf of the Ministry of Transport, by Mr. J. P. Scott Main. The resultant report, apparently because of its importance, is being treated as a special case, and was issued as an independent document on Monday last.

AN unfortunate development that may follow the railway strike in Northern Ireland is that some portions of the Great Northern Railway may not be reopened for passenger traffic. The sections likely to be closed for such traffic are Dungannon to Cookstown, Goraghwood to Armagh *viâ* Markethill, and Banbridge to Scarva. On the Antrim branch very drastic reductions of the service will probably be made.

THE automatic signalling between Camden and Watford, to which we last referred on September 9th, 1932, has now reached Colne Junction, Bushey, and so approaches completion. The lines being so equipped are those used for the electric trains, and when they were opened were controlled by signal-boxes that were independent of the parallel two fast and two slow lines. The provision of the automatic signals has allowed for seven of the electric lines signal-boxes to be dispensed with.

MENTION has recently been made in the Press, in connection with a revival of coastwise traffic, of a bi-weekly service of boats between London, Ipswich, King's Lynn, and Boston, which is said to be part of a scheme of development by the King's Lynn Docks and Railway Company. As that is a little-known concern, it may be useful to hear that it possesses very little railway. The annual Railway Returns show that it has 1 mile 50 chains of running line, and 10 miles of sidings, but it has 4824ft. of length of quay. It joins the former Great Eastern in the parish of Gaywood, and has no locomotives or rolling stock. It was incorporated in June, 1865. The company hopes to rebuild the position of King's Lynn as a gateway to the Eastern and Midland Counties.

THE twelfth International Railway Congress, which was opened in Cairo on January 20th, closed on Monday, January 30th. Hitherto, the Congress has met at five-year intervals—except that there was none between that at Berne in 1910 and the Rome meeting in 1922—but, at Madrid, in 1930, it was decided that the intervening periods should be three years. As related in the leading article on this subject in THE ENGINEER of January 13th last, many have considered that the latter interval was too short, and that was reflected in the information given in some of the reports. The matter was discussed at Cairo, and it was resolved to revert to the former interval of five years, and the thirteenth session will, on the invitation of the French Government, be held in Paris in 1938.

THE circumstances that contributed to the collision of January 28th at Three Bridges, Southern Railway, between an electrically operated passenger train and a goods train, have been inquired into by Lieut.-Colonel Anderson, but, in view of the absence, through injuries they sustained, of the guard of the goods train and the motorman of the passenger train, the inquiry was adjourned. The case has been made of unusual interest because it is alleged that the injured motorman remarked that the glare of the colour-light signals prevented his seeing the red tail lamps of the goods train. We may, however, remark that the tail lamps are a minor consideration, as the passenger train would be controlled by fixed signals, which should have been at "danger" in consequence of the signalman having the goods train standing at his box and because they would be locked by that train occupying the track circuit.

THE Great Western Railway report for 1932 contains for the first time, and therein follows the example of the L.M.S. and L.N.E. companies, a summary of the financial results for the year. The report, among other matters, mentions the death of two of the directors, and intimates that the vacancies have not been filled, as it is desired to ascertain whether, under present conditions, the duties of the board can be carried out satisfactorily with a reduction in numbers. A resolution will be submitted to the annual meeting that it be left to the discretion of the directors whether or not these, and any future vacancies should be filled. There was spent, on capital account, during the year, £1,660,423, of which £1,432,174 went on works, £66,714 on locomotives and rolling stock, £68,069 on land and buildings for manufacturing and repairing works, and £66,521 for plant for those works. It is proposed to spend £2,469,000 on capital during the present year, of which £1,000,000 will go on 20-ton wagons, £18,000 on containers, £28,000 for manufacturing and repairing plants and works, £110,000 on modernisation of docks in South Wales, and the remainder on works. The traffic receipts, when compared with 1931, fell from £26,893,480 to £24,512,951, a decrease of 8·85 per cent., whilst expenditure was reduced from £21,809,168 to £20,488,654, or 6·05 per cent. Maintenance of way and works was reduced from £3,215,240 to £2,936,605; maintenance of rolling stock from £3,603,443 to £3,203,306; locomotive running expenses from £5,139,836 to £4,941,490, and traffic expenses from £7,538,501 to £7,173,136. Coaching train mileage was brought down from 39,586,111 to 29,422,777, and goods train mileage from 22,875,379 to 21,966,916. Out of every 20s. earned from all sources 11s. 7d. was paid out in salaries and wages, and 4s. 4d. on interest and dividends on capital.

Notes and Memoranda.

A WRITER in *The Machinist* gives the following formula for 50 gallons of non-corrosive cutting compound:—47 gallons boiled water (cooled to room temperature), 3 lb. borax, 3 gallons soluble oil, 1 lb. tri-sodium phosphate.

ON long belt conveyors it has been found, says Mr. W. E. Warne, that power driving every second or third idler has many advantages. Wear is considerably reduced, and it permits the using of a thinner belt and smaller head and tail pulleys.

TWO cases of the formation of bluish or violet specks in white paint on iron have been investigated recently in Germany, and the opinion has been held that these specks are due to cobalt compounds used as driers, and the investigation indicates iron and not cobalt as the source of the discoloration.

RESEARCHES carried out by a German firm have shown that the corrosion of copper, brass, and similar containers by liquid motor fuels not entirely free from sulphur, can be prevented by the addition of turpentine, amylene, derivatives of tetralin, &c. These compounds appear to form peroxide-like derivatives, which fix the sulphur in a similar manner to the vulcanisation of rubber.

RIVETED structures of galvanised steel have not been popular because of the difficulty of protecting the rivet heads against corrosion. A new method, described in *Power*, follows normal procedure in that galvanised sections are riveted together in the usual way, but afterward a special tight-fitting circular flanged cap of heavy-gauge zinc is soldered over the head. The caps are airtight and prevent corrosion of the rivet heads.

IN a new method for constructing concrete foundations, tunnel and shaft linings, the aggregate is first dumped *in situ* and cement grout is pumped into it through pipes having their open ends at the bottom of the loose aggregate. This method, invented by two German engineers, has been found efficacious in saturated soils, has rendered the lowering of the water table or insulation by sheet piling unnecessary, and is stated to be considerably cheaper than ordinary methods, especially when concrete must be placed under water.

IT has been shown that in comparing fabricated steel construction with that of iron or steel castings, substantial savings can be made on account of the lighter weights of the welded products, and the *Welder* says, in comparison with iron castings, the actual cost of fabricated steel construction shows savings of from 25 to 60 per cent., depending on the suitability of the subject being treated. In comparison with steel castings the savings are not so great, but in numerous instances (and in dealing with castings weighing from 2 tons to 10 tons) the savings by fabricated construction have been 15 to 45 per cent.

THE ideal plant for a modern colliery designed to raise 3000 tons per day, would, states Mr. J. A. Melling, be two pulverised-fuel-fired boilers, two steam winders, a steam-driven fan, and a mixed-pressure turbo-generator, and everything else driven electrically. The chief advantage of the steam winder over the electric, in addition, of course, to its lower operating cost, is its flexibility. Should it be necessary to have a little extra speed in order to get either men or coal out of the pit, the steam winder can usually accomplish it; not so the electric winder. Once the maximum speed has been settled upon, it is fixed.

EXPERIENCE in the U.S.A., says the *Engineering News-Record*, has shown that aluminium booms for excavators can be constructed of the same length as steel booms at a saving of 40 to 50 per cent. in weight without sacrificing the strength and rigidity of the heavier boom. In general, however, this saving in weight is utilised by increasing the length of the boom and the capacity of the bucket. In the average drag-line the strength-weight ratio of the strong aluminium alloys will permit an increase of 15 to 20 per cent. in the length of the boom, or an increase of 20 to 25 per cent. in the capacity of the bucket.

A 3000 kW, 600-volt, single-unit, grid-controlled, mercury-arc rectifier was discussed in a paper by E. H. Reid and C. C. Herskind before the American Institution of Electrical Engineers. An important characteristic of this rectifier unit is its operating temperature, materially higher than any heretofore used in general practice. Tests show that, up to a certain temperature, arc drop is reduced as temperature is increased. This indicates that maximum efficiency is obtained by operating at temperatures giving the lowest arc drop. Among other advantages of high-operating temperature is increased cooling efficiency.

THERE are many problems in the natural-gas industry connected with gas measurement and the estimation of natural-gas reserves that deal with the relationship between pressure and volume. Many engineers, when solving these problems, assume that natural gas conforms with Boyle's law, which states that at constant temperature the volume occupied by a gas is inversely proportional to the absolute pressure. However, this simple relationship as expressed by Boyle's law is not strictly applicable to natural gas, and the amount of deviation from the law depends upon the temperature, pressure, and chemical composition of the natural gas. A technical paper on the subject has been issued by the United States Bureau of Mines.

SHORT welds have been made by laying a rod along the line of the weld and starting the arc by shorting the rod end with a carbon pencil. This principle has been applied in a "self-consuming" automatic welding process of Champion Rivet Company, for welds of any length. The welding machine is simply a long, narrow table with a bus-bar at one side, from which contact arms extend at 16in. intervals. A heavy welding rod with excentric coating is placed in a V, with the contacts touching the bared metal. From each contact arm there also extends a carbon pencil contacting the coating. High-frequency current is superimposed on the welding circuit to strike an arc by means of the carbons. The rod thus is fused, the excentricity of the coating both protecting the fusion and directing it. Welds can thus be made in any position.

Miscellanea.

THE engine overhaul of the "Olympic" has been completed, and after sea trials she will re-enter service on March 1st.

ON Saturday last, the aircraft fleet of Imperial Airways completed 10,000,000 miles of flying, in which there have been only five accidents involving passengers.

STOCKHOLM'S first underground railway, connecting the southern suburbs with the city, is under construction, and it is expected to be completed by October next.

A CONFERENCE of the representatives of the Madras Government, the South Indian Railway, and the Madras Corporation has been convened to consider the construction of bridges over the railway level crossings in Madras City.

THE four lowest tenders received by the Iraq Government for building the Habbaniyah irrigation works are those of the Humphrys Dywidag Anglo-German group, the Nuttall-Mowlem group, Messrs. Lindsay Parkinson and Messrs. Balfour Beatty.

THE Sorima Company's salvage vessels "Rostro" and "Cefalo," are about to start operations on a Norwegian cargo boat wrecked twenty years ago off the Tunisian coast. The vessel had a cargo of copper and animal fat, valued at about 3,000,000 lira.

DURING the reconstruction of the Buctouche River Bridge, New Brunswick, three steel spans were moved from one set of piers to another in about four minutes, and traffic, on a main trunk highway, was held up for only four minutes while the realignment was taking place.

Two bridges, one built over the other, to form a crossing at three separate levels for two highways and a main line railway, have recently been built in Newark, N.J. The bridges consist of a reinforced concrete highway arch of 122ft. span carrying a park drive over the railway and a flat slab reinforced concrete railway bridge that passes over a main state highway.

PRELIMINARY arrangements are now being made for an International Oil Industries Exhibition, covering all aspects of the oil industry, to be held at the Royal Agricultural Hall, Islington, from July 19th to 25th next. It is being organised by Kinematograph International Exhibitions, and is stated to have the patronage of the leading oil companies, allied industries, and scientific bodies.

IN White Russia the repair of tractors for the grain-sowing campaign is reported to be so far behind time that all hopes of the completion of the work by March 15th have been abandoned. The tractors belonging to the Potato Department are nearly all broken down, and of 502 requiring serious repairs only forty have been attended to. Of the Flax Department's 628 tractors, only forty-three have been repaired.

IN order to cope with increased orders resulting from the preference given at Ottawa by the Dominions to British cream separators, R. A. Lister and Co., Ltd., of Dursley (Glos.), are laying down a new cream separator factory at their Dursley works. Building operations have already begun. The new separator factory, which will cover over 70,000 square feet, will be equipped with the latest mass-production machinery.

DURING the last few years a sum of about £80,000 has been spent on new buildings, laboratory equipment and endowment in the Engineering Colleges, University College, London, and every effort has been made to ensure thoroughly modern training in the scientific principles on which engineering practice is based. An interesting brochure, describing the courses of study in the Faculty of Engineering, has just been issued by the College.

THE announcement is made that H.R.H. the Prince of Wales has consented to be Patron of the British Association for Commercial Education, which has for its future object the co-ordination and stimulation of efforts on the part of employers, of educationalists, and of parents to raise the standard of entrants into commerce; to promote the further education and training of those engaged in commerce, and thereby to advance the interests of British trade at home and abroad.

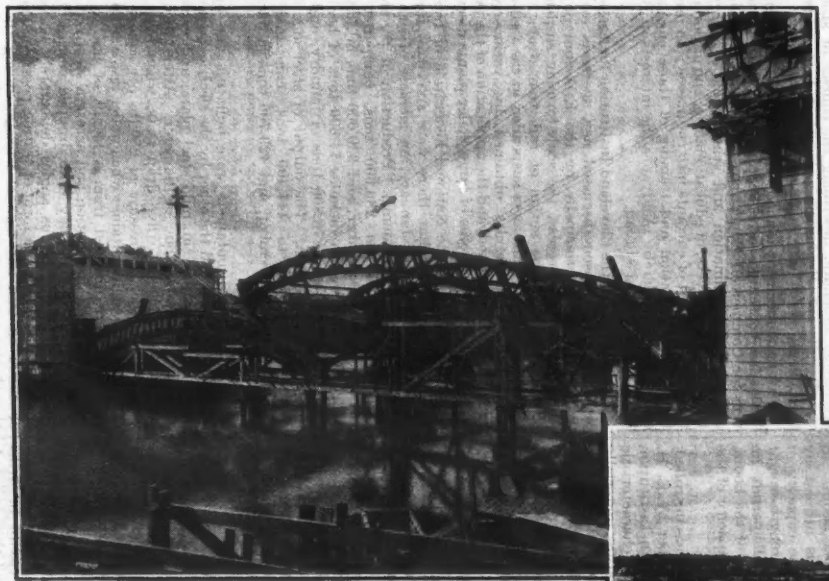
AT a meeting of the Cleveland Institution for Engineers, Mr. H. O. Thompson discussed new methods for feed water treatment, principally by the Etherium physical process. In this process, the scale-forming suspensoids are deposited by the action of radiations from "activators," or sealed containers suspended in the feed-water tanks. Practical results obtained by various water companies were outlined, and the application of the process to the feed-water systems of large boiler plants discussed.

IT is reported by the National Federation of Iron and Steel Manufacturers that there were sixty-two furnaces in blast at the end of January, an increase of two since the beginning of the month. Production of pig iron in January amounted to 286,600 tons, compared with 284,500 tons in December, and 330,000 tons in January, 1932. The production includes 74,600 tons of hematite, 126,000 tons of basic, 76,800 tons of foundry, and 8300 tons of forge pig iron. The output of steel ingots and castings amounted to 444,400 tons, compared with 430,000 tons in December, and 429,700 tons in January, 1932.

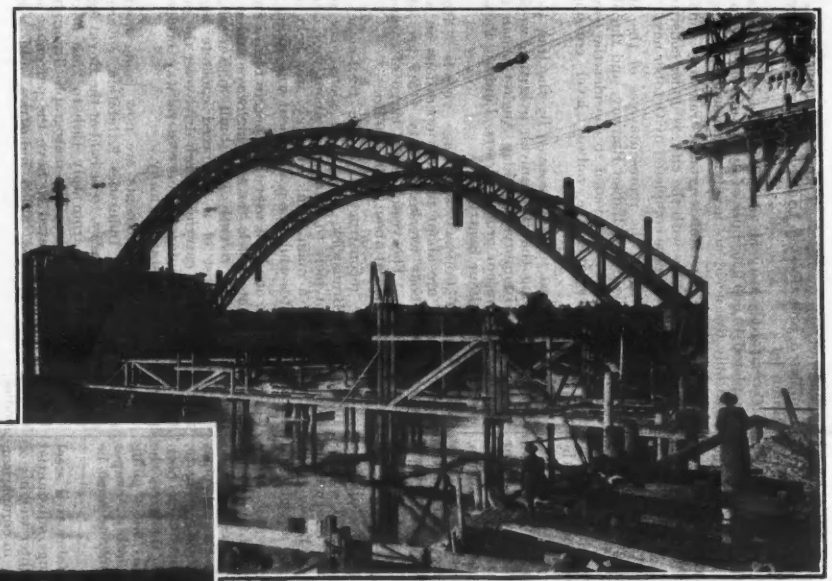
RECENTLY two containers were built up, one by the acetylene process, and the other by the electric arc process. They were made in ⅜in. mild steel plate, and each was 9ft. 7½in. long and 26in. in diameter. After fabrication each was subjected to five drop tests, when filled with water, and under a pressure of 250 lb. per square inch. The weight of each container when under test was 30 cwt., and they were dropped from a height of 6ft. to 10ft. on to a concrete foundation and across a steel rail so as to deform the weld. They were dropped vertically, and when inclined at various angles deliberately chosen to ensure the most drastic form of testing possible. Neither container showed any sign of leakage during the tests, though the extent of the bouncing or rebound indicated that temporary indentation at the moment of impact was much more severe than the permanent deformation.

NEW GREY ST. BRIDGE BRISBANE QUEENSLAND.

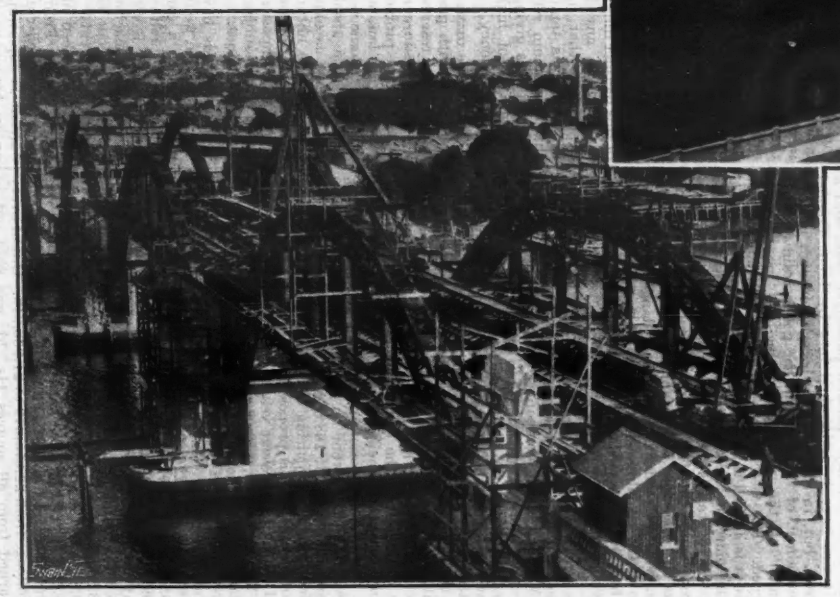
(For description see article elsewhere in this issue.)



The steelwork of the arches was supplied in sections. The half-arches, riveted together on a wooden staging——



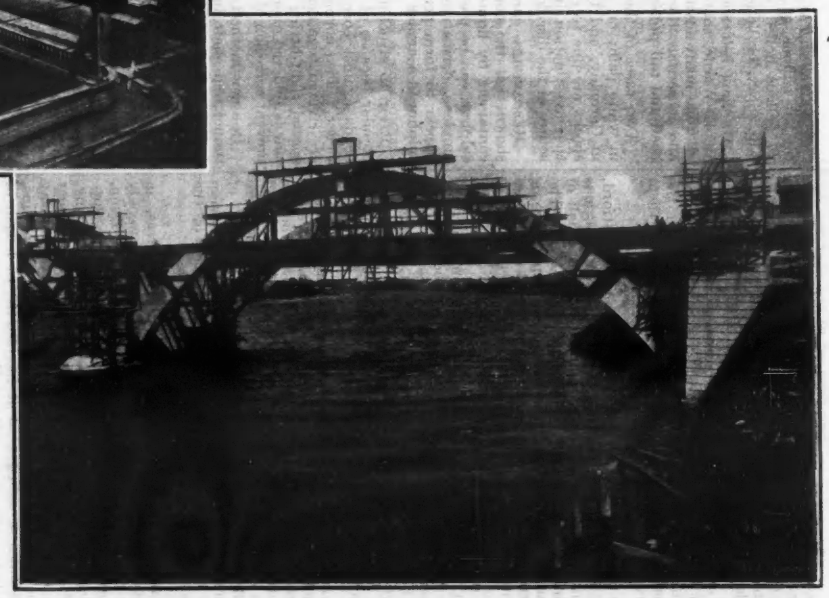
——were subsequently hoisted up and lowered away until, meeting at the crown, they became self-supporting.



The Bridge is of steel arch construction encased in pre-cast concrete voussoir sections.

Left :—In this view the arches are seen approaching completion and the erection of the deck is in hand.

Right :—The encasing concrete of the arches was cast in voussoir sections and set into position from a staging.



The Engineer

FEBRUARY 24, 1933.

VOL. CLV. No. 4024

Contents.

THE ENGINEER, February 24th, 1933. PAGE

A SEVEN-DAY JOURNAL .. 185
NEW BRIDGE AT BRISBANE, AUSTRALIA. (Illus.) .. 186
THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM. No. II. (Illus.) 187
A NEW STRUCTURAL STEEL. (Illus.) .. 188
TURBO-ELECTRIC LINER "QUEEN OF BERMUDA." No. I. (Illus.) 191
PRODUCTION OF A VACUUM BY MEANS OF A STEAM JET. (Illus.) 192
ACCIDENTS TO PLATELAYERS .. 194
INSTITUTION OF CHEMICAL ENGINEERS .. 194
BRITISH STANDARDS INSTITUTION .. 194
RAILWAY AND ROAD MATTERS .. 195
NOTES AND MEMORANDA .. 195
MISCELLANEA .. 195
LEADING ARTICLES—
Unemployment and the State .. 197
Locomotive Driving Wheels .. 197
THE AIR EJECTOR—INSTITUTION OF MECHANICAL ENGINEERS .. 198
LETTERS TO THE EDITOR—
Rubber Research—Grain Handling—Oil-electric Locomotives—Employment of Engineers from the East—All-steel Railway Coaches .. 199
SIXTY YEARS AGO .. 199
INSTITUTION OF MECHANICAL ENGINEERS .. 200
2-8-2 "MIKADO" FREIGHT LOCOMOTIVE. (Illus.) .. 200
PROGRESS OF FUEL RESEARCH .. 201
RAILWAY CARRIAGE DISINFECTING PLANT. (Illus.) .. 201
A NEW SWITCHING KIOSK. (Illus.) .. 201
ELDERSLIE DOCK PUMPING PLANT. (Illus.) .. 202
CONCRETE ROADS. (Illus.) .. 202
A MOTOR COMPRESSOR UNIT. (Illus.) .. 203
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 203
Lancashire .. 203
Sheffield .. 204
North of England .. 204
Scotland .. 205
Wales and Adjoining Counties .. 205
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 205
CONTRACTS .. 205
CURRENT PRICES FOR METALS AND FUELS .. 206
FRENCH ENGINEERING NOTES .. 207
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 207
FORTHCOMING ENGAGEMENTS .. 208

EIGHT-PAGE SUPPLEMENT—THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM; SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

NOTICES TO READERS.

*** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** For Subscription rates see page 2 of Advertisements.*

*** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

The Metallurgist.

THE FEBRUARY NUMBER OF THE METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE

UNEMPLOYMENT AND THE STATE.

A SHORT time ago, as recorded in our "Journal" page last week, Mr. Ramsay MacDonald informed Bethnal Green that the Government had decided to give no more grants for unemployment relief works. On Thursday, February 16th, Mr. Lansbury moved in the House of Commons a vote of censure on the Government for its attitude towards unemployment, and referred specifically to the Bethnal Green letter. His speech was, in part, emotional, in part a restatement of the principles of Socialism, and in part a contention that all the relief works carried out since 1920 were not "a burden on the community." Replying to Mr. Lansbury, Mr. Chamberlain advanced the arguments which formed the substance of the Bethnal Green letter. Relief works were only tolerable as a cure for temporary unemployment. Such works could not be carried on indefinitely by the State. He had made a rough estimate and found that from April, 1924, down to September, 1931, the capital value of State-assisted works for the purpose of providing employment was about £700,000,000. Of that sum, £450,000,000 went on housing, £90,000,000 on roads, £120,000,000 on unemployment grants, and £40,000,000 in grants by the Lewis Committee. Mr. MacDonald, speaking later, said that "three millions had been put to employment on work that was unproductive, unnecessary in itself, had no market; three million people were living on incomes created by the mass of their fellow-workers. Every pound was income derived from capital. The question of unemployment relief was not the whole policy of the Government. That policy included the restoration of National and International Trade." Mr. Lansbury's motion was defeated by a great majority.

For generations public works have been carried out by States in order to diminish unemployment. But no economists—save those who believe that all expenditure should be made by the State—have ever regarded them as other than an ill means of preventing a worse ill. It must be clearly understood that unemployment relief works are works that would not otherwise be executed, or not executed at that time. They are allotted with the specific intention of employing the out-of-work: they are not State undertakings for which labour would have to be found, even if there were no abnormal unemployment. Regarded strictly within the terms of this definition, the objections to such works, from an economical point of view, are manifest and have been so often discussed that to detail them again would be waste of ink. But whilst, despite their defects, such works may be, even must be, tolerated as a temporary measure they are intolerable as a permanent burden upon the State. At the beginning of a period of unemployment, relief works may be of a kind which, sooner or later, will benefit the nation; but, as time goes on, such works are exhausted, and if the relief is continued the money is expended on undertakings which are unnecessary. At that position this country has now arrived. Some 540 million pounds sterling have been spent by the State in no more than five years on relief works. To perpetuate an expenditure in the neighbourhood of 100 million pounds a year upon supererogatory undertakings is unthinkable. Not only would it be waste of money, but it would be the misuse of money taken from possible productive investment. Every penny spent on such futile works would have to be withdrawn, by taxation, from industry or from those developments which lead to the increase of industries. Hence, the effect of the works carried out for the relief of unemployment would actually tend to perpetuate and increase the evil they were designed to relieve. In other words, unemployment can never be cured by increase of taxation, and, conversely, it might be mitigated by the reduction of taxation and the consequent encouragement of buying and the increase of investments in productive enterprises. We have just received from Mr. Sydney Upton a pamphlet entitled "Peopling the Empty Empire," which shows what opportunities there are for the development of engineering schemes in the Dominions. Such schemes would take many of our unemployed overseas for the good of the Empire as a whole. How can they be carried out when the money needed for them is being withdrawn from the potential investor by taxation to meet the cost of unproductive work at home?

In his letter to the Borough Councillors of Bethnal Green, Mr. MacDonald said that the object to which the Government was directing its attention was the improvement of trade. We can scarcely conceive that it has only just awakened to the fact that increase of commerce is the only cure for unemployment. Rather must we believe that, through the past long months of world depression, it has felt that nothing could be done, and that there was no other course than to provide vast sums for relief, whilst waiting for trade to revive as it always has done by its own processes. The change of policy may be due mainly to the fact that, in the opinion of the Government, the tide has at length turned, even though, if Mr. Neville Chamberlain is right, ten years must elapse before it is at the flood; but we may, nevertheless, rejoice in the Prime Minister's general condemnation of relief works and his obvious intention no longer to pursue that facile method of keeping men in employment. His words must be taken to imply—and for that reason, no doubt, are so greatly resented by Socialists—that the Government intends to leave the expenditure of money to industrial capitalists and to help them to spend it profitably in the country by encouraging all means of improving the condition of trade. We shall await with interest manifestations of the direction which the Government proposes to adopt in pursuit of this object, and we sincerely trust that it will not overlook the statement so frequently made by bodies well qualified to express an opinion, that a reduction of taxation is amongst the primary necessities.

Locomotive Driving Wheels.

PROFESSOR DALBY'S article on the diameter of driving wheels, printed in our issue of February 10th, will undoubtedly have been read by many who are interested in the finer points of steam locomotive design, more especially because our contributor is so well known as an authority in that particular field of mechanical engineering. It is an undoubted fact that for any given engine there is a best cut-off for a given speed of rotation, from which it, of course, follows that if a locomotive is designed for running at a more or less definite mean speed, then there must be a most suitable diameter for the driving wheels. We may further say, therefore, that if the speed be changed, so also must be the cut-off. In our issue of April 11th, 1930, page 501, will be found the statement that for any one speed there is only one cut-off at which the engine will deliver its maximum horse-power or its draw-bar pull, and mention is made of a practice followed by the New York Central in having tabulated information giving cut-offs for different speeds, prepared for different locomotives, and issued to enginemen for their guidance in operating the engines to the best advantage. All locomotives have a best cut-off for any one speed of rotation, and it does not always follow that the shortest cut-offs are the most economical so far as steam consumption is concerned; moreover, it actually seems that it is only at the higher speeds that the very short cut-offs produce low steam rates.

As Professor Dalby says, little is definitely known of the effect of variations in design; that is, the form of ports, passageways, and valves. But here and there experiments have and are being made. Poppet valve gears are gradually coming into use and long lap piston valves have done much to improve steam distribution at all speeds of rotation, and more especially so when associated with short maximum ratios of cut-off, for then much better port openings to steam are attained at the shortest of running cut-offs. However, experimental data thus far available, and for the most part gleaned from test plants in the United States, go to show that, for any given cut-off, an increase in rotational speed is accompanied by a decrease in the mean pressures, and that this fall in pressure is greater for a given increase in speed at the longer ratios of admission than for the earlier cut-offs, whilst at the shortest cut-offs an increase in speed between quite wide limits influences comparatively little the mean effective pressures. That such should be the case is, of course, quite understandable, because under the latter conditions the volume displaced by the pistons during the period of admission is small and the piston speed is at its lowest. Actually the choice of wheel diameters for a given engine and service conditions is largely, like others connected with locomotive proportions, a matter of personal opinion, and also, quite naturally, is dependent on the general design of the engine. It will be remembered that for many years the four-coupled passenger locomotives of the old Lancashire and Yorkshire had wheels no less than 7ft. 3in. in diameter, and we believe Sir John Aspinall, their able designer, deliberately selected this diameter because he appreciated the fact that for a given speed in miles per hour at a stated cut-off, the actual mean pressure would be greater than were he to employ a smaller wheel. It is on record by competent observers that these large-wheeled engines surmounted the many severe gradients with which this line abounds as well as, if not better than, those having smaller wheels. On the other hand, Rous-Marten found during his numerous speed investigations that Stirling's 7ft. 7in. "singles," with a 26in. stroke, performed better than the same designer's 8ft. "singles," with the then long stroke of 28in.; but in spite of this, Churchward's six-coupled engines, with 6ft. 8in. wheels and a 30in. stroke, have run as well as those having the same wheel dimensions but only a 26in. stroke. In support of this statement we may recall the fact, mentioned in our issue of September 7th, 1923, that one of the 30in. stroke engines worked the "Cheltenham Flyer" on its inaugural trip. It is not without interest to notice that although the four-cylinder engines had a 26in. stroke, yet Mr. Collett's "Kings" not only have smaller driving wheels, namely, 6ft. 6in. against the previous standard of 6ft. 8in., but that this reduction in wheel diameter is accompanied by a lengthening of stroke to 28in.

It used to be said that the best speed for a locomotive is about 250 revolutions per minute, and in a general way it would seem that most designers wittingly or unwittingly work to this rule, and proportion the diameter of the driving wheels accordingly, paying little attention to the question of piston speeds. How an increase in piston speed may be expected to influence the mean pressure, and if this factor is of greater importance than an increase in revolutions per minute, would form a fitting subject for scientific inquiry. It could be investigated, in company with many other locomotive problems, only under the conditions of a properly constituted research station. Professor

Dalby reminds us in his article that a full report had been made on a proposed station of that kind, and that even an appropriate site for it had been selected. Most unfortunately, the presentation of that report coincided with a demand for rigid economy, not only by the Department of Scientific and Industrial Research, but by the railway companies themselves. We still hope that when prosperity returns it may be taken out of its pigeonhole and that, at length, this country may become possessed of an adequate plant for the complete testing of all possible types of railway locomotives.

The Air Ejector.

INSTITUTION OF MECHANICAL ENGINEERS.

AT the Annual General Meeting of the Institution of Mechanical Engineers, on Friday, February 17th, after the presentation of the Annual Report, the details of which are given on another page, and its unanimous adoption, the Secretary announced the result of the ballot for membership of the Council. The result of the election is as follows: President, Mr. A. E. L. Chorlton; Vice-Presidents, Mr. F. H. Livens and Eng.-Vice-Admiral Sir Robert Dixon; Members of Council, Mr. Cecil Bentham, Prof. F. C. Lea, Sir Ernest Petter, Eng.-Vice-Admiral Sir Reginald Skelton, Prof. Dempster Smith, Sir John Thornycroft and, as Associate Member, Dr. G. A. Hankins. The President then said the moment had arrived for him to invite Mr. Chorlton to occupy the chair. Mr. Chorlton was well known to all the members of the Institution. He was a C.B.E. and a Member of Parliament. He was also a native of Lancashire, the ancient home of mechanical engineering in this country. Mr. Chorlton inherited the qualities of Lancashire engineers—energy, independence, and persistence. Whitworth and Nasmyth had been natives of Lancashire. They were proud to have in Mr. Chorlton another Lancastrian. Mr. Chorlton having had a scientific education, was apprenticed to Mather and Platt, and seven years after the termination of his apprenticeship he became works manager of that business. That showed his ability. He had joined the Institution in 1903, been elected to the Council in 1921, became Vice-president in 1928, and now he was to be President. After remarking upon the deep sense of responsibility that must be felt by the holder of presidential office, Mr. Taylor formally invited Mr. Chorlton to take the chair.

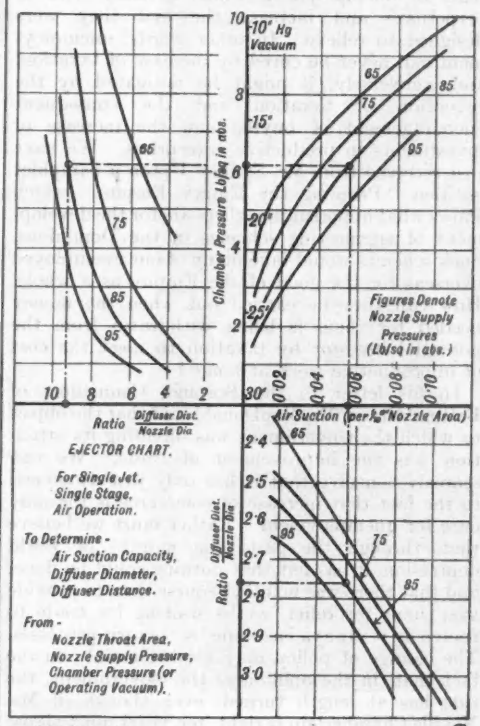
In reply, Mr. Chorlton said he was proud to achieve that great distinction. The responsibility was heavy, but, aided by the loyalty of the Council, he hoped he would find it not so difficult to carry. If he did as well as his predecessors, he would do very well indeed. The new President then called upon Mr. R. W. Allen to propose a vote of thanks to Mr. Taylor.

Mr. Allen said that Mr. Taylor had been an ideal President, conscientious and painstaking, and his meeting in Canada had been a great success. The vote was seconded by Mr. Tookey, who, speaking from the body of the hall, expressed the respect and gratitude of the members of the Institution to the retiring President. Mr. Taylor replied in a short speech gratefully acknowledging the support he had received from the Council and the work that had been done by General Mowat and his staff.

The new President, Mr. Chorlton, then called upon Mr. F. R. B. Watson to read his paper on "The Production of a Vacuum in an Air Tank by means of a Steam Jet." An abstract of this paper will be found on page 192.

The discussion was opened by Dr. Mellanby, who had a number of slides to show, and provided a great deal of information. Space prohibits us, unfortunately, from reprinting his remarks in full. He considered that the paper was of great value, as well as of scientific importance. At first sight it might be thought that it was of no great importance how the pressure rise was divided in two and three-stage ejectors. It had, however, a considerable effect. [Two slides were exhibited to show the total work done and how the work was divided between the stages of a three-stage ejector.] If the pressure rise was the same in each stage the work was very unevenly divided. The low-pressure stage did 90·8 per cent. of the work. If, however, the design was such that there was equal work done in each stage, the total work done was nearly halved as compared with the previous case. The division of the pressure rise was therefore very important. The author of the paper appeared to favour over-expansion of the steam issuing through the nozzle, as giving the best results. Personally, he did not think that was the case. A diverging nozzle was only suitable for a certain range. If the back pressure was not suitable, the steam expanded beyond that pressure and recompressed again. In doing so it put itself in a very bad state for doing work. [The speaker showed a slide indicating the pressure gradient within a nozzle discharging against various back pressures to illustrate his point.] All turbine designers knew that to allow the back pressure to rise was objectionable. The jet of steam under such conditions left the boundary walls of the nozzle altogether. It was, however, a problem how that was to be demonstrated. [A slide was thrown on the screen showing a jet issuing from a glass nozzle. The standing waves within the nozzle had rather the effect of a trellis work.] Air had been used for the experiments, and not steam, as in the author's case. The slide showed an over-expanded jet, and it was to be observed that the standing waves disappeared at the re-compression point. The reason for this disappearance seemed to be that while in the early part the jet was filling the nozzle, later it left the surface, and there was consequently no definite boundary for reflection. The point was even more clearly demonstrated by another slide. By covering the sides of the nozzle with black oil, that part of the jet which was filling the nozzle carried away the oil from the walls, so that where the oil was left in position it indicated that the jet had left the surface. He was not sure that in the recompression stage the jet was capable of doing work.

The apparatus that had been used for conducting experiments on ejectors was illustrated by a slide. It was similar to that of the author, but a sliding nozzle was used instead of a movable diffuser. The author of the paper had laid stress upon the importance of the distance between the outlet of the nozzle and the beginning of the


10" Hg Vacuum
15"
20"
25"
30"
Chamber Pressure Lbs/sq in abs.
Figures Denote Nozzle Supply Pressures (Lbs/sq in abs.)
Air Suction (per sq" Nozzle Area)
Ratio Diffuser Dist. / Nozzle Dia
EJECTOR CHART.
For Single Jet, Single Stage, Air Operation.
To Determine -
Air Suction Capacity, Diffuser Diameter, Diffuser Distance.
From -
Nozzle Throat Area, Nozzle Supply Pressure, Chamber Pressure (or Operating Vacuum).
"THE ENGINEER"

DESIGN CURVES FOR AIR EJECTOR

throat of the diffuser. Personally, he attached greater importance to the design of the diffuser itself, particularly to the inlet angle and the length of the throat. He thought that the diffuser adopted by the author of the paper should have had a larger throat. The size of the diffuser was also of great importance. [A slide was exhibited indicating the pressure drop in the nozzle and the rise in pressure in the diffuser, as determined by a search tube.] When the jet was bigger than the diffuser, violent oscillations of pressure occurred. Other slides showed the "trellis" of standing waves for good conditions of optimum diffuser distance and throat area, and the effects of varying diffuser designs and throat lengths on the jet. One of the most interesting slides which the speaker exhibited and discussed is reproduced on this page. By the use of these curves an actual apparatus could be designed to specification. From the constant nozzle pressure curves of vacuum against suction quantity, the capacity of each ejector unit in the plant could be deduced and hence the number of units required to deal with any specified quantity of air. The diffuser diameter and the throat distance from the nozzle to give the best results could then be read off on these curves which had been derived from the results of tests. For example, if the stage vacuum was to be 17·5in. and the nozzle supply pressure 85 lb. per square inch absolute, then the capacity and the dimensions for unit nozzle size could be read off as indicated by the dotted lines. [The chart is contained in a paper by A. D. Third, entitled "The Air Ejector," and published in the *Journal* of the Royal Technical College of Glasgow, 1927.] The scope of the chart, said Dr. Mellanby, applied only to air operation, but there was no reason why it should not be extended to cover practical requirements. He was surprised to hear the author say that nothing had been published on the subject. Much of his information had been taken from the paper mentioned above, which was to be found in the library of the Institution.

Mr. Fitt said he was sorry he had not heard of the other paper to which Dr. Mellanby had referred. His remarks would be made from the point of view of a turbine designer. The air ejector might be regarded as the labourer to the turbine. He thought the author's paper correlated information on the subject, but considered that experimentation with one stage did not help very much when 29in. of vacuum was required. The normal ejector for that vacuum was a two-stage one. The position of the nozzle was of considerable importance, but it was different for the two stages. In the primary the outlet of the nozzle should be far back if the air was to be properly entrained, but in the secondary it could be placed quite a long way down the diffuser. He attributed considerable importance to smooth easy flow, with no sharp corners for the air to negotiate. The author's steam-air ratio of 6·6 to 1 was too ambitious; 10 would be nearer the mark. The only convenient method of examining the conditions in the nozzle and diffuser was by search tube. The presence of the tube must, however, have an upsetting effect. A relative result was obtained, but he questioned whether it was the actual one. There was controversy over the correct degree of expansion of the steam from the nozzle. Some manufacturers considered over-expansion the best. If over-expansion occurred, it was possible that in the positions of reduced pressure air was entrained with good effect. He considered that in the design of combining tubes what looked best to the eye was best for the steam. There should be a nice clean sweep with no sudden turnings. Tapers of 1 in 12 to 1 in 16 were suitable for the combining tube and a compression ratio of 5 or 6 to 1. The parallel part of the tube gave stability to the turbulent steam. One of the biggest bugbears of the ejector designer was "upsetting." The diffuser throat must be kept full of mixture.

Mr. Gresham described some experiments he had made in placing rods down the centre of the steam jet. A plain rod caused disturbance, but by shaping the end of the rod as a "torpedo," he found that at a certain critical pressure the amount of steam could be reduced without altering the effect. If the pressure was then altered, the "torpedo" vibrated like a tuning fork. He was not sure that the centre part of the jet of steam played any part, but for vacua greater than 25in. it was of importance. In an apparatus of his own, similar to that of the author, he had arrived at proportions that gave good results. He had been able to maintain 21½in. at 80 lb. per square inch, 25in. at 90 lb. per square inch, and 28in. at 100 lb. per square inch and above. He thought the best position of the diffuser for maximum air flow differed from its corresponding position at no air flow. Had the author altered the position? [The author here stated that the position of the diffuser had been the same for both conditions.] He thought, however, that the position of the diffuser was relatively unimportant. Its size was the important point. The angle of the diffuser adopted by the author should have been narrower. He believed in over-expansion.

Mr. I. V. Robinson said his work on the subject had been carried out prior to 1926, and no paper had been published then. The diameter of the throat was very important. If it was too small, the steam jet alone filled it. The steam entrained the air by friction, and if the jet filled the throat the air on the outside was "rubbed" off. Under properly designed conditions, the steam and air together filled the throat, while if the throat was too large the air eddied back. A parallel throat enabled the air to become stable in the divergent part. He had found the paper hard to follow, and thought the designer would have difficulty in applying the results. That was not so in the case of the diagram shown by Dr. Mellanby.

Mr. Verity showed some slides illustrating experiments he had carried out some years ago. He pointed out that the duty which an ejector had to perform varied considerably according to the conditions. If it was designed for certain particular conditions, it might be all wrong for others. The curves in one of his slides showed that for maximum vacuum the distance between the end of the nozzle and the throat of the diffuser increased as the steam pressure was reduced.

After Mr. Watson had replied shortly to the discussion, the meeting terminated.

By thirty-one votes to twenty-six the House of Lords, on Wednesday, February 15th, carried a motion, proposed by Lord Buckmaster, that it was in the public interests that the Ministry of Transport be dissolved and its functions distributed among other Departments.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

RUBBER RESEARCH.

SIR,—I should be glad if you would give the opportunity of calling the attention of engineers to the critical position of the Research Association of British Rubber Manufacturers, whose fate now depends upon the action of the House of Commons.

This Association, founded thirteen years ago with the assistance of the Department of Scientific and Industrial Research, has built up a very valuable organisation, which not only serves its own industry, but also co-operates freely with other organisations which have an interest in the use of rubber for their own purposes, or in the supply of machinery or materials to the industry. For this purpose it has developed research and technical laboratories and an unrivalled intelligence service, and possesses an experienced staff which is now in danger of disbandment.

The industry, consisting of a large number of firms differing greatly in size, is a difficult one to organise for research on a voluntary basis. Accordingly, the Association, with the support of the majority of firms and all the responsible trade organisations concerned, has prepared a scheme by which a stable and adequate revenue would be secured by a small levy (one forty-fifth of a penny per pound) on raw rubber, on the same lines as the levy on cotton for the encouragement of cotton growing in the Empire, and on coal for financing the Miners' Welfare Fund. Some such scheme is regarded as essential, one reason being that the larger units, which are capable of carrying on research in their own establishments, cannot be expected to bear most of the cost in the common interest except on the understanding that all units contribute on a relative scale. The present difficulties arise from the fact that such a levy requires Parliamentary sanction, and that it is very difficult to carry a Private Members' Bill through the House of Commons against even slight opposition. Consequently, the Association will be compelled to cease operation within a few weeks unless the passage of the Bill, which is again before the House, is immediately assured.

The engineer cannot be indifferent to such a development, since he is interested in many ways in the technical efficiency of the rubber industry. The automobile industry could never have developed to anything approaching its present state without the pneumatic tire, and even now, when the tire has reached such a pitch of perfection, further developments in tire design and building have to be considered in close relation to the design and springing of the whole car. Apart from tires, rubber is entering more and more into the construction of motor cars, railway rolling stock equipment, and other machinery. Furthermore, developments in the technique of rubber manufacture call for new machinery which it is the function of the engineer to supply.

I may mention one particular development which may now be delayed. There is no authoritative handbook where the engineer can find the physical and chemical properties of rubber set out for his own use in a readily usable form. In the case of steel and other constructional materials, he can readily turn up data on strength, modulus of elasticity, permanent set, and the like, for design purposes, as well as details of methods of test to be applied to these materials. The Research Association, in collaboration with the Rubber Growers' Association, is engaged in the preparation of a corresponding handbook for rubber, but it is feared that this project will be suspended.

Attempts have been made to decry the work of the Association, but invariably by those who have never supported it on a voluntary basis, and, therefore, are not in a position to know and appreciate its value, since the main results of its research are confidential to members. The simplest reply to these criticisms is the continued support of its original members, and its rapid increase of membership even in times of unprecedented depression. This firm was one of the original members, and I should like, on their behalf, to state their view that, whatever provision the average rubber manufacturer makes for the scientific management of his own factory, there is a definite need for a central scientific organisation which can deal with problems of common interest, supply an intelligence service of published work, and serve as a scientific link with the supplier, the consumer, and with other industries. We are satisfied that it is in the interests of the industry that this Association should continue its work on an adequate basis and under proper working conditions, and we hope that every possible step will be taken to secure the passage of the Rubber Industry Bill now before Parliament.

ALEX. SPENCER,
Chairman, George Spencer, Moulton and Co., Ltd.
Westminster, S.W.1, February 18th.

GRAIN HANDLING.

SIR,—In his lucid and comprehensive paper on the "Handling and Storage of Grain," the author states that "unloading of box-cars into the track-hoppers is usually effected by power-shovels." In that he is not entirely correct. The provision of power-actuated car dumpers is surely an essential feature of any modern terminal of any capacity, and for years unloaders of the "Dominion-Howe," "Link-Belt," and "Richardson" types have been installed in all the larger plants. The terminals of the United Grain Growers and the Saskatchewan Pool at Port Arthur, the Vancouver plant of the Alberta Pool, and the Canadian Government elevator at Churchill, come to mind as having car-unloaders of the first type. The operation of this car-dumper may be of interest to some of your readers.

The car, having been spotted roughly by the car-haul machinery, is located and fixed on the platform above and parallel with the receiving hopper by means of two clamps or knuckles, which engage the couplings at each end of the car. A hinged door-breaker then pushes the grain door away from the side and lifts it to the roof of the box-car. This frees a large quantity of grain, which flows over the sill into the receiving pit below. A long steel baffle, with a curved outer end, is then inserted diagonally in the car, and the machine is tilted longitudinally towards the end from which the baffle is inserted. This empties all the wheat from one end of the car, which is then relevelled. The baffle is retracted, and a second baffle is inserted from the other end, and the tilting operation repeated. This completely empties the car, which is then removed, after relevelling. All operations are electrically operated.

It should be stated that the tracks on either side of the unloading shed are usually on a gradient, the car-haul being used only to start the stationary cars, which are afterwards handled by gravity as far as practicable.

In discussing "Shipment by Water," Mr. Broughton mentions that one large lake-carrier was loaded with 550,000 bushels of grain in five hours. This feat, which still stands as a record, was performed at Pool Terminal No. 7 at Port Arthur. The vessel was the s.s. "Lemoyne," of which mention is made earlier in the paper. The writer, while identified with Messrs. C. D. Howe and Co., was engaged upon the design of this plant.

Considerable interest is being taken in "moving-form" construction, and I am sorry that Mr. Broughton has not given us a little further information as to the "power-driving" of the jacks as practised by the Barnett McQueen Construction Company, of Fort William. Several years ago this firm dispensed with hand-jacking, and developed a very successful and economical system operated by electricity. Instead of the levers shown in the illustration to your contributor's article, a chain-sprocket is fitted. The form is divided into units about three or four bays long, by the width of the structure. A continuous roller chain is wound round each of the sprockets, of which there are usually eight for each cylindrical "bin." The roller chain is driven through a reduction gear by an electric motor. By this method the jacking gang is reduced to one or two men. The motors, shafts, reducers, and chains can, of course, be re-used a great many times, although the capital cost is fairly heavy.

The author states that flat bars on edge are used for storage-bin reinforcement; but, in the Canadian West, as far as my experience goes, rods of ¾in. diameter are most frequently used, the spacing being varied to suit the lateral pressure. The vertical pressure is usually accommodated by a somewhat thicker wall of richer mix for about 10ft. above the bin-bottom slab.

Mr. Broughton is to be congratulated upon an excellent paper, and for the splendid illustrations.

GWYN ROBERTS-LEWIS.

Dagenham, February 15th.

OIL-ELECTRIC LOCOMOTIVES.

SIR,—I have just read Mr. Thorley's letter in your issue of February 10th.

Of course, I ought to have said "alleged" heavy torque recoil. It is quite easy to produce a Diesel locomotive fitted with a medium-speed engine driving through mechanical gearing which will compare favourably with a three-cylinder steam locomotive in that respect. So far as steam engine flexibility is concerned, I agree with Mr. Thorley's remarks, and on the line mentioned in my letter it can certainly be produced, and at a reasonable price.

K. W. WILLANS.

Glasgow, February 18th.

EMPLOYMENT OF ENGINEERS FROM THE EAST.

SIR,—I should like, through your columns, to correct an impression which appears to be very prevalent among engineers in high places when seeking to engage engineers on their staffs.

I find that men who have spent a number of years out East are not looked upon favourably as candidates for such posts, on the ground that they have been out of touch with modern design, workshop practice and management. I believe this to be a very mistaken assumption, and I am speaking from twelve years' experience in the Far East.

As a general rule the engineer in the East has got to keep thoroughly up to date, and, having to depend altogether on his own knowledge to tackle and carry out work to a successful issue, he takes very good care to keep in touch with the very latest developments in the class of work for which he is responsible.

The successful engineer from the East certainly develops a resourcefulness due to conditions and opportunities which are denied to his "stay-at-home" brother. I have personal knowledge of many workshops in remote parts of the Far East which are far ahead of the average shop in this country, largely because their managers are men of wide views and broad experience and not at all adverse to using other than English catalogues when ordering their machinery and materials if they consider they can get more suitable equipment by so doing.

Many employers have rather hazy ideas as to duties and responsibilities of engineers in the East; otherwise these men would be considered equally desirable to the engineer at home.

EASTERN ENGINEER.

February 21st.

ALL-STEEL RAILWAY COACHES.

SIR,—In your issue of February 10th Mr. C. J. Kavanagh takes me to task for my interpretation of Mr. H. N. Gresley's report to the Cairo meeting of the International Railway Congress Association.

I am interested to observe that the very admirable summary of this report which appeared in THE ENGINEER of February 3rd, on page 109, bore out my own interpretation. Indeed, Mr. Kavanagh's letter is largely answered by your summary. Since Mr. Gresley was reporting on behalf of all the British railways, his statement cannot be regarded as applying to one railway alone. The argument that, because railways overseas utilise all-metal construction (and Mr. Gresley's report covered the railways of the United States, Dominions, Colonies, China, and Japan), therefore the home lines should follow suit, disregards differences in climatic conditions, prices of materials and traditional skill. In the last named, this country is undoubtedly ahead of all others as regards wooden body construction. To compare Pullman cars with ordinary coaching stock would seem to beg the question, and incidentally all-metal Pullmans have been running for four years on the "Queen of Scots" (L.N.E.R.). If Mr. Kavanagh will refer again to Mr. Gresley's report, he will find specific reference to the difficulty of including numerous side doors with strong steel construction. Pullman cars are only fitted with end doors, a practice which has been largely forced on many Continental railways through the adoption of all-metal construction.

C. E. R. SHERRINGTON.

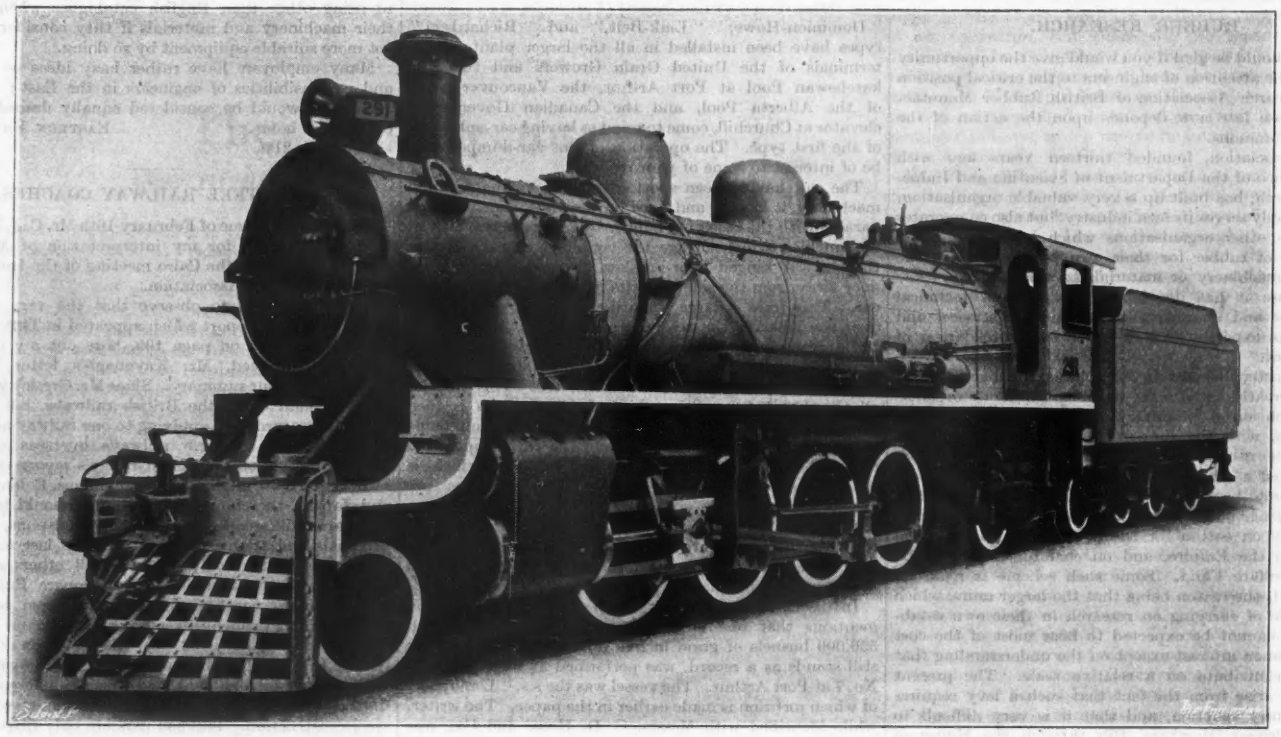
Belmont, Surrey, February 20th.

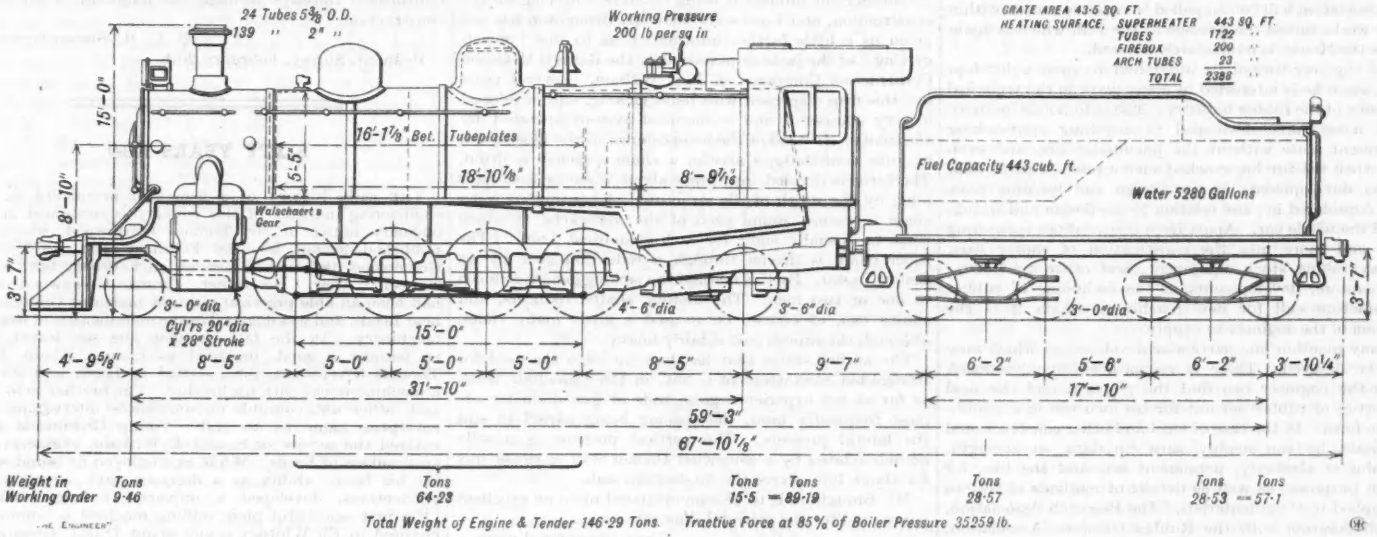
SIXTY YEARS AGO.

THE early history of a firm still prominent in the engineering industry of this country is contained in the obituary notice of Mr. Thomas Greenwood, which we published in our issue of February 21st, 1873. Mr. Greenwood had died in London on February 9th, in his sixty-fifth year. His father, Thomas Greenwood, sen., had been an able practical machine maker at Gildersome, near Leeds, and was engaged in the manufacture of woollen machinery. In the father's shop the son learnt how to become a good, practical workman. About 1833, Thomas Greenwood, jun., settled in Leeds and started a machine works with his brother. The brother soon died and, other unfavourable circumstances intervening, the enterprise came to an end. Young Greenwood then entered the service of S. and J. Witham, engineers and tool makers of Leeds. While so employed he found scope for his latent ability as a designer, and, among other productions, developed a universal milling machine. [The first successful plain milling machine is commonly credited to Eli Whitney round about 1818.] Greenwood attracted the attention of Sir Peter Fairbairn, for whom Witham's made tools for the production of flax machinery, and in 1843 Sir Peter appointed him principal draughtsman at Wellington Foundry. A few months previously Mr. Batley had also entered Sir Peter's service, and in 1848 Greenwood and Batley were taken into partnership. The Crimean War brought a sudden demand for improved methods of manufacturing munitions. Greenwood's services were at once sought for the purpose of re-equipping the machine departments of Woolwich Arsenal, and in a short time he had devised machines for making fuses and rockets and moulding and casting machinery for shot and shell. In 1856 Greenwood and Batley dissolved partnership with Fairbairn, and started a machine-making business of their own at Albion Foundry, East-street, Leeds. The connection with the manufacture of munitions of war was continued, and, inspired by Greenwood's genius, the new firm was entrusted with the design and supply of the machines required for the production of Armstrong guns, shells and fuses at Woolwich and Elswick. Machines based on the American interchangeable system of manufacture were later supplied to the Enfield Small Arms Factory. The East-street foundry soon became too small for the firm's increasing business, and fresh accommodation had to be erected in Armley-road, Leeds. In this establishment silk spinning, flax and rope-yarn spinning machinery were added to the firm's productions. During the Franco-German War Mr. Greenwood and Mr. Batley, in conjunction with Mr. Westley-Richards, established a works at Birmingham for the manufacture of small arms and ammunition. That establishment eventually became merged into the National Arms and Ammunition Company, Ltd. Towards the end of his life Mr. Greenwood became interested in the manufacture of boots and shoes by machinery, and became chairman of a company formed to produce the machines required. He was described as an enlightened employer of labour who constantly showed great consideration for the physical and moral welfare of his workpeople. His workshops were well lit, well ventilated, well swept, and orderly. He was the first to introduce the Saturday half-holiday into the Leeds machine trade, and the first to concede the nine-hours day.

CHINESE GOVERNMENT RAILWAYS—FREIGHT LOCOMOTIVE

NASMYTH, WILSON AND CO., LTD., MANCHESTER, ENGINEERS





Institution of Mechanical Engineers

THE annual report of the Council of the Institution of Mechanical Engineers was presented at the meeting of the Institution held on Friday, February 17th. During the year 1932 the membership roll increased by 134 to 11,295. Examinations for admission to the Institution were held in April and October in London and at a number of centres in the provinces and overseas. Candidates to the number of 103 passed the studentship examination and 363 the associate membership examination or parts thereof. The Institution now has ten local branches, a new one, the North-Eastern Branch, having been inaugurated during the year. In addition there are four Graduates' Sections. Examinations for National Certificates and Diplomas in Mechanical Engineering were held at 124 technical schools and colleges in England, at four central institutions in Scotland, and at certain institutions in Northern Ireland. All told, 2829 candidates presented themselves for these examinations. Ordinary certificates were gained by 1146 candidates and higher certificates by 401. Ordinary diplomas were awarded to 42 candidates and higher diplomas also to 42.

For the Alloys of Iron Research Committee work was continued at the National Physical Laboratory, the alloys under examination being those of iron with manganese. For the purpose of this research manganese of a very high degree of purity is being produced by a distillation process. The study of the iron-manganese system has been rendered difficult because the alloys at the iron-rich end of the scale reach equilibrium so slowly that in order to fix certain lines in the equilibrium diagram annealing for a year or more may be necessary. For the Cutting Tools Research Committee, Mr. E. G. Herbert investigated the fluctuations of hardness and ductility which occur in tool steels during and for some hours after heat treatment, and has studied the relationship between these fluctuations and the periodic fluctuations set up by magnetic treatment and by mechanical deformation. The object in view is to improve the efficiency of tool steels by methods alternative or supplementary to processes commonly used for hardening tools. Mr. Herbert has presented to the Committee a report entitled "The Ageing of Tool Steels."

A small exploratory committee was appointed in connection with a proposed research into the strength of pipe flanges in high-pressure, high-temperature steam plants. The Welding Research Committee under Professor F. C. Lea has prepared a programme of research, which includes experimental work to determine the mechanical properties of weld metal at different temperatures. Corrosion tests on the weld metal and tests to ascertain the effect of heat treatment on its mechanical properties will also be made. The research on wire ropes was continued at Woolwich Polytechnic, and the results of the investigations in hand will, it is expected, shortly be embodied in the Committee's fifth report.

On the financial side the Council's report shows that the total revenue of the Institution for the year was £34,052 12s. 6d. and the total expenditure £33,623 18s. 1d.

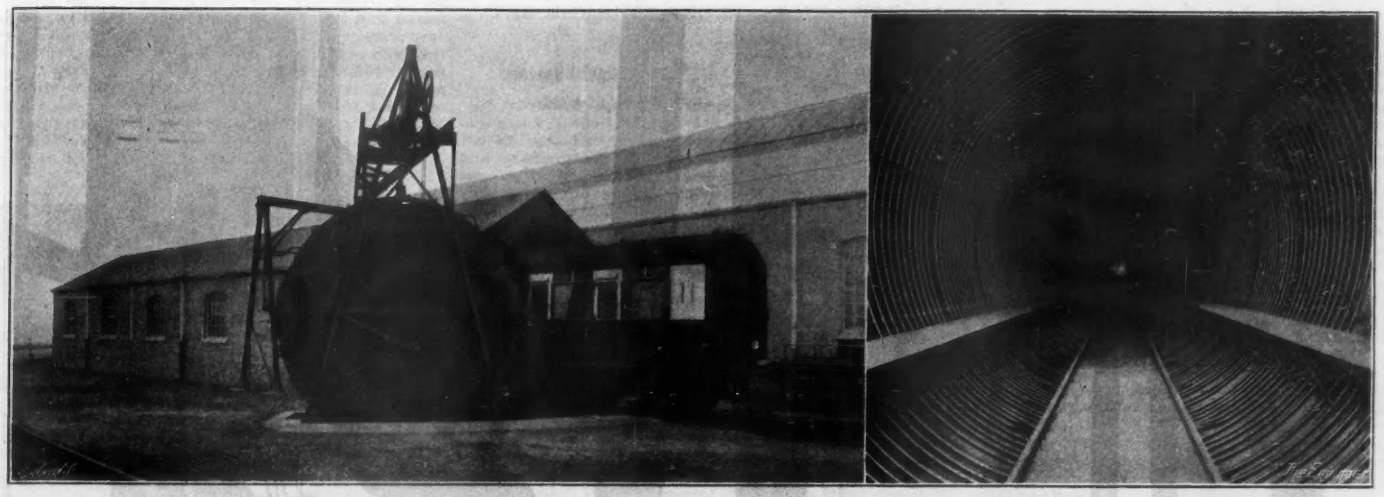
2-8-2 "Mikado" Freight Locomotive for China.

WE illustrate above a 2–8–2 "Mikado" freight locomotive, one of eight which have recently been constructed by Nasmyth, Wilson and Co., Ltd., Manchester, for the Chinese Government Railways, Tientsin Pukow Line, to the order of the Chinese Government Purchasing Commission for the Ministry of Railways, China, out of the China Indemnity Fund. They are for 4ft. 8½in. gauge, and each, together with its bogie tender, weighs 146·29 tons. The boiler is designed for a pressure of 200 lb. per square inch, and has a total heating surface of 2388 square feet, made up as follows:—Tubes, 1722 square feet; superheater, 443; fire-box, 200; and arch tubes, 23. The grate area is 43·5 square feet. The ends of the longitudinal joints in the boiler shell, the bottom of the combustion chamber and the tubes at the fire-box end are all welded. The wrapper plate inside the fire-box and in the combustion space are in one piece, and the dome is forged out of one plate and is weldless. The tubes are of solid drawn steel and the distance between the tube plates is 16ft. 1⅞in. The fire-box is of steel and has an extended combustion chamber, and the fire-brick arch is supported on tubes. The smoke-box is fitted with a spark arrester, and the fire-door of the butterfly pattern can be opened and closed, either manually or by air pressure. The fire-box side stays and flexible stays in the breaking zone are all made of wrought iron, and the boiler equipment includes two clearing holes with large wash-out plugs, having screwed caps, a divided steam turret, one side for saturated and the other for superheated steam; three "pop" safety valves; a five-chamber chime whistle; two non-lifting injectors, which deliver into the top feed clack-box; water gauges, with prismatic glasses; a boiler pressure gauge and dual pressure gauge with connections to the exhaust and steam passages of the cylinders; and a steam boiler tube cleaner.

The steam cylinders are 20in. diameter and 28in. stroke. They are cast integral with the valve chests and smoke-box saddle and the cylinders and valve chests are fitted with cast iron liners. The valves are of the piston type with inside admission and the valve gear is of the Walschaerts pattern, while the reversing gear is of the single-cylinder power-operated type for operation either by steam or air pressure. Air valves are fitted on the steam chests and water relief valves on the cylinder covers, and there is a drifting valve with connections to the cylinders. The cylinder drain cocks are automatically operated by steam.

The frame is of the bar type, and is cut out of solid steel slabs, the rear end being spliced and joggled. It is recessed to receive the steam cylinders which are secured vertically and horizontally by driven bolts and wedges. The boiler is attached to the frame by means of five breather plates. The eight-coupled driving wheels are 4ft. 6in. diameter, and the rear truck wheels 3ft. 6in. diameter, while the front truck runs on 3ft. wheels. The driving wheels have

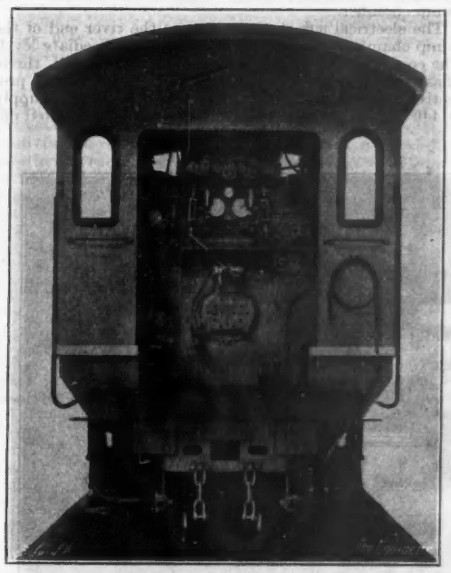
RAILWAY ROLLING STOCK DISINFECTING PLANT AT SWINDON



bronze hub liners, and the axle-boxes are of cast steel with bronze bearings. The springs over the coupled-wheel axle-boxes are compensated.

The leading truck is of the swing link type, and the rear truck is of the radial arm pattern. The cab is lined with teak and has upholstered seats for the driver and fireman. It has sliding side windows. The engine and tender are equipped with the Westinghouse air brake, both automatic and straight, and there is a separate hand brake on the tender. The Westinghouse air pump is of the cross-compound type, and besides supplying air for the brakes also deals with the sanding apparatus and the signal bell, which is situated on top of the boiler.

The tender has a fuel capacity of 443 cubic feet, and



CAB OF CHINESE LOCOMOTIVE

the water tank holds 5280 gallons. It is of channel construction throughout and has two diamond frame bogies. Standard type "D" automatic couplers are fitted with Bradford rocker type friction draft gear and two-key attachment.

The engines were built under the supervision of Messrs. Sandberg, consulting engineers, London.

Progress of Fuel Research.

THE Fuel Research Board in its Annual Report for the year ended March 31st, 1932, issued on February 20th by the Department of Scientific and Industrial Research, states that the financial crisis that occurred in the summer of 1931 necessitated special consideration of the research programme with a view to possible reduction of expenditure. An endeavour was made to secure that any slowing up of the work should be applied to those items which were less likely to produce immediate results of practical importance.

Low-temperature Carbonisation in Brick Retorts.—An experimental brick retort has been working satisfactorily and steadily at the Fuel Research Station since November, 1930, and work is in progress on the erection of a setting of two brick retorts of the latest design and a setting of two intermittent vertical chamber ovens. The excellent results obtained with the brick retort, together with the increasing difficulty of keeping the charge moving in cast iron retorts, owing to retort distortion, have led to the abandonment of experiments in cast iron retorts. Using a medium caking coal—"Dalton Main"—a throughput of 10 tons per day has been maintained with the brick retorts, giving a yield of coke containing approximately 9 per cent. of volatile matter, and suitable for use as a domestic fuel in open grates. Tests have also been carried out to discover the effect of carbonising wet coal taken straight from coal washeries. A series of trials has been carried out to see how far the brick retort was suitable for producing a satisfactory lump smokeless fuel from small coal, and what throughput could be attained with such coals. The slacks used—caking and non-caking—were all of low ash content, and some were specially washed at the Station before use. They were blended when necessary. Throughputs of up to 6 tons per day were attained. No serious difficulty was encountered in working the retort satisfactorily with this small-sized coal and good smokeless fuels have been produced.

Treatment of Tar.—It has been shown that tars, produced at temperatures below about 800 deg. Cent., can be converted in the laboratory to excellent motor spirit and Diesel oil, with the entire elimination of pitch. A comprehensive scheme is in hand intended to develop such processes and to show how far they can be made an economic as well as a technical success. It is proposed to erect plant by which two separate lines of treatment of the resultant tar can be carried out. In one case the tar will be hydrogenated to produce motor spirit and heavy oils, with the elimination of pitch; in the other, the tar will be treated by fractional distillation.

The new brick retorts mentioned above will provide a range of tars of known origin with which to experiment. For hydrogenation cracking a high-pressure converter is being designed to deal with some 200 to 300 gallons of tar per day. Stills are being provided for the distillation of the crude tar or of the products of treatment, and a refining plant for the spirit, whether obtained by scrubbing the gases, by straight distillation, or by hydrogenation. A tower 30ft. high is being erected at the Fuel Research Station to house the reaction vessel, at the foot of which will be a control room, spirit refinery, workshop, office, &c.

Tests carried out on samples of motor spirit prepared by hydrogenating coal and low-temperature tars indicate that the samples have considerably higher anti-knock values than that of the petrols at present marketed in this country. When added to a straight run petroleum spirit, ten parts of the hydrogenated spirit were found to be equivalent to six parts of benzene.

Hydrogenation of Coal.—The hydrogenation of coal is effected by subjecting it to a temperature of about 450 deg. Cent. in an atmosphere of hydrogen at a pressure of some 200 atmospheres. The result is that a large portion of the coal substances is converted to a liquid, and by this method a greater proportion of motor spirit and fuel oil can be obtained from the coal than by any other known means. Imperial Chemical Industries, Ltd., has developed the process, originally suggested by Dr. Bergius, and has worked a plant dealing with 10–15 tons of coal a day. It is clear, however, that the cost of production of motor spirit from coal would be considerably above the present import prices of petroleum products.

The effect of a large number of catalysts upon the hydrogenation of a particular coal, Beamshaw coal (Yorkshire), has been studied on a small scale.

The proportion of catalyst added in the earlier experiments was 2·5 per cent. of the coal, but, with the discovery of more active substances, this has been progressively reduced until 0·1 per cent., or less, is commonly employed.

In the normal hydrogenation process the powdered coal is made into a paste with tar and forced under pressure into a converter. The Report records the progress made in a modified hydrogenation process, in which a stream of hydrogen under pressure passes over coal, maintained at 430 deg. Cent. in the absence of any pasting medium. Arrangements were so made that the hydrogen proceeding from the vessel containing the coal passed directly into another vessel in which was supported a catalyst maintained at 450 deg. Cent. The oil vapours, together with the hydrogen, were thus submitted to a further treatment, and on condensation yielded a pale brown very limpid product, of which 85 per cent. was volatile below 230 deg. Cent. The yield of spirit, boiling-point up to 230 deg. Cent., from this test amounted to 140 gallons per ton of dry ash-free coal.

Pulverised Coal.—A departure from existing methods of burning powdered coal is made in the "vortex" combustion chamber under development at the Fuel Research Station, in which an attempt is made to control the motion of both the fuel particles and the air required for their combustion, in order to obtain the relative motion requisite for rapid combustion in a small space. It is also hoped by this means to deal with fuel of a coarser nature than that usually required for powdered fuel firing.

Coal Survey.—The organisation of the Physical and Chemical Survey of the National Coal Resources of the country is now complete, and work is steadily proceeding in all areas.

Much coal, especially for use in gasworks, is marketed on its volatile content. In some areas, rapid variation in the volatile matter of a coal seam is found. In some such cases, as a result of the sampling carried out by the Coal Survey, it has been found possible to draw on a map, with fair accuracy, lines representing equal volatile matter content. These lines show at once the trend of the variation at any point, and indicate the direction the workings should take if it is desired to keep the volatile matter in the coal produced within certain limits.

Railway Carriage Disinfecting Plant.

AN interesting plant for disinfecting railway rolling stock has just been built at the Swindon Works of the Great Western Railway Company. As will be seen from the two engravings above, it consists of a long, low building, capable of accommodating the longest coaches. It has a circular door at the end, which is capable of sliding and swinging aside in a manner reminiscent of that of an airship shed. The coach is driven into the building and the door firmly closed behind it. The second engraving, which, at first sight, might be taken for a reproduction of a photograph of a tube railway tunnel, represents the interior of the building, which consists of a steel cylinder 85ft. long, 16ft. 6in. in diameter. Steam pipes almost completely encircle the coach when it has been run in. Once the coach is in position and the air-tight door has been closed, the temperature within is raised to 120 deg. Fah. by steam heating, whilst at the same time an air pump comes into operation and creates a vacuum of 28in. of mercury. These conditions, believed to be fatal to all vermin, are maintained for six hours.

Should the vehicle or vehicles have been exposed to infectious diseases, an additional treatment is desirable. Liquid formalin, introduced from a small supply tank, is evaporated by steam heat, and the resulting formaldehyde gas is drawn through perforated tubes into the cylinder. When the vacuum is destroyed, the gas penetrates to every part of the vehicle, thoroughly disinfecting everything, including cushions, bolsters, rugs, &c. The new plant is expected to be particularly useful for disinfecting vehicles used for the conveyance of flour and grain.

A New Switching Kiosk.

MAINLY with a view to meeting the requirements of rural electrification schemes, Ferguson, Pailin, Ltd., of Higher Openshaw, Manchester, have introduced an interlocked switching kiosk incorporating a round tank series trip type oil circuit breaker arranged for vertical isolation. The illustrations on page 202 show a pole-mounted equipment, but the kiosk may be used in various other ways, and an arrangement is available for floor mounting in any position. Simple design and modern methods of protection are said to enable the kiosk to be supplied at a price comparable with that of contemporary switch and fuse gear which does not afford the same standard of performance and convenience of operation. The circuit breaker is tripped on a new principle involving the use of a gas expansion device with a renewable element which can be replaced in a few seconds. Inside the element there is a heater strip connected in series with the supply circuit and surrounded by a substance which generates gas immediately the heater strip reaches a temperature of 287 deg. Cent. The expansion of the gas gives a powerful and rapid tripping action and at the same time actuates an interlock which prevents the breaker being reclosed until the element is replaced. The makers explain that as immediately the gas expands the heater strip is short circuited there is no danger of the strip being fused and causing a power arc to be set up in the element. Short-circuit tests have shown that the circuit breaker can safely be rated at 100 amperes at 11,000 volts.

The standard arrangement includes triple-pole overload trips, with the mechanism for each phase mounted on the top of the front terminals of the breaker, the mechanism being coupled to the manual closing lever gear by means of insulating links. The overload trips have an inverse

POLE-MOUNTED SWITCHING KIOSK

time limit characteristic and are said to be unaffected by damp. Positive tripping is obtained at low-current values and the tripping force is said to eliminate the possibility of the breaker sticking. Another desirable characteristic claimed for the apparatus is a close ratio of tripping current to normal current.

The equipment illustrated forms a complete interlocked control unit which does not need additional isolators. The kiosk is composed of fabricated sheet steel and steel sections, and the expansion trip oil circuit breaker is arranged for vertical isolation by means of an operating mechanism actuated by an endless chain, the breaker being balanced by a sliding weight hinged to the bottom sheet of the kiosk. Very little effort is said to be necessary when performing the raising and lowering operations, and an automatic catch on each side of the breaker holds it in the isolated or "plugged-in" position. Interlocks prevent the breaker being moved to these positions without the breaker being in the "off" position, and as the breaker is lifted by the tank it can only be plugged in when the tank is in its normal position. Moreover, in the event of the breaker being tripped by one of the operating elements it cannot be closed until the element is replaced by a new one.

The kiosk may be mounted on a single pole or on A or H poles with equal facility at a convenient height for operation, the breaker handle being pulled down when it is desired to close the circuit, whilst after tripping the breaker is lowered by the balanced mechanism to the isolated position to enable the element to be renewed. As the breaker tank does not have to be opened up for this purpose the time occupied in making the breaker completely ready for service again is only one and a-half minutes. Spare elements are supplied with each equipment and spent elements are recharged at the makers' works. The first illustration on the left shows a kiosk mounted on a pole, the middle illustration the kiosk with the bottom cover opened and the breaker in the isolated position, while the right-hand illustration shows the breaker lowered for renewal of the tripping elements.

Elderslie Dock Pumping Plant.

IN last week's issue we described the Box type of entrance gate designed and supplied by Sir William Arrol and Co., Ltd., for the new No. 2 Elderslie Dock constructed by Sir Robert McAlpine and Son, Ltd., for Barclay, Curle and Co., Ltd. By the courtesy of Drysdale and Co., Ltd., of Yoker, we are now able to give an account of the pumping plant for the de-watering of the dock. The pumping station and electrical sub-station consists of an underground chamber, 45ft. by 25ft. by 29ft., which is built into the south wall of the dock at the dock gate end. The arrangement is such that there are no obstructions or buildings above ground except the companion way for access to the pump house. It thus permits full use of this important part of the dock coping for manipulation of hawsers, shores, and the passage of the dock crane over the working length of the dock.

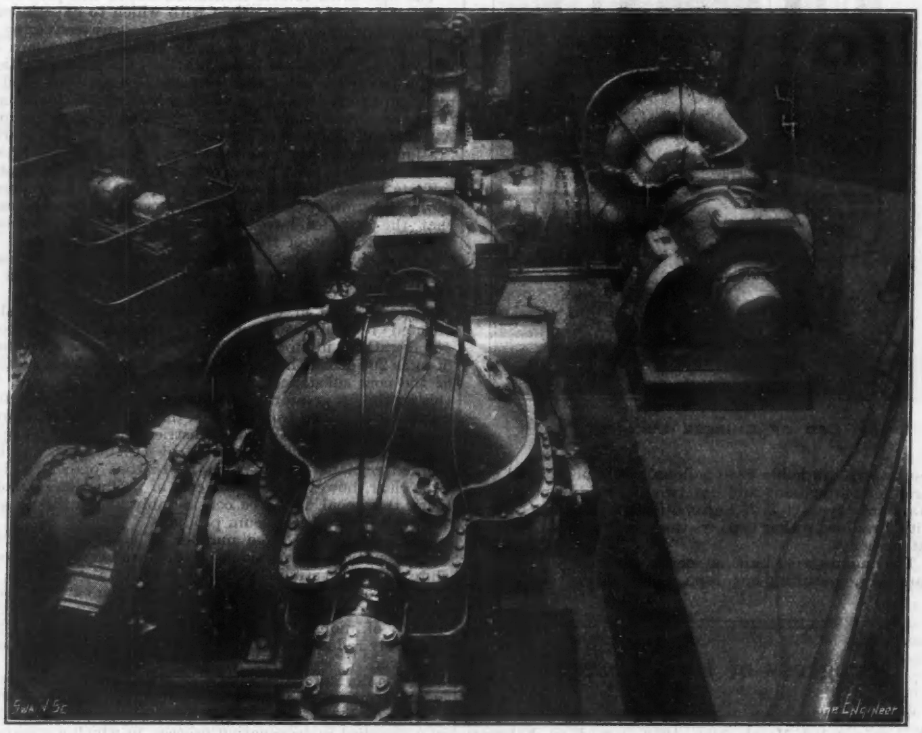
The main dock pumping plant comprises two Drysdale horizontal divided-casing centrifugal pumps, each designed to deliver 50,000 gallons of water per minute. The pumps are direct coupled to British Thomson-Houston Company's three-phase enclosed type ventilated motors. The total pumping capacity is 100,000 gallons per minute, and on a recent test the time for de-watering, with a level of water 27ft. over the sill of the dock, was two hours, the makers' guarantee of 2½ hours being considerably improved upon. Both the pumps draw from a large chamber placed below the level of the bottom of the dock, and immediately under the floor of the pump chamber, the water flowing into the chamber from each side of the dock through bar gratings. It is also possible by isolating the chamber through penstocks to connect the pumps to culverts leading to No. 1 Elderslie Dock, so that the new plant can under emergency conditions also pump out that dock.

In designing the plant special attention was paid to the ease of controlling, starting, and stopping the pumps as, in the process of docking large liners, it is essential that the pumping requirements shall be immediately responded to. Each pump discharge is furnished with a Glenfield and Kennedy electrically operated sluice valve, and the same firm's patented tilting disc reflux valve. The level of the water in the suction chamber is indicated by a Kelvin, Bottomley and Baird "Pneumercator" pneumatic depth gauge, which enables the attendant from the pump platform to see the level of the water in the dock. Any leakage into the dock after de-watering has taken place is dealt with by a 3000-gallon per minute pump with duplicate suctions, one direct to the main sump and the other to the outside of the isolating penstock, so that during the period of emptying No. 1 dock the leakage water for No. 2 dock can be handled by the outside connection.

A novel arrangement for priming either the main or auxiliary pumps has been adopted by the use of a new form of rotating vacuum pump of the Drysdale "Aquair" type, which, by speedily evacuating the air, enables the main pumps to be started up even although the water may be 15ft. below their level.

Any drainage water inside the pump chamber is handled by a vertical pump driven by a direct-coupled motor and complete with automatic float operated switch, controlled by the level of the water in a sump sunk in the floor of the pump chamber.

The electrical sub-station occupies the river end of the pump chamber, and is arranged on an intermediate level. The equipment comprises a 1000-kVA, 11,000-volt, three-phase, 50-cycle transformer with H.T. isolating and protective switchgear, meters, &c. The low-tension supply at 440 volts is led to a series of ironclad floor-mounted oil-immersed circuit breakers of George Ellison's manufacture.



UNDERGROUND PUMPING STATION, ELDERSLIE NO. 2 DOCK

In this part of the pump chamber are also installed the special motor generator and control gear for the Austen equipment for the dockgate winches, which was referred to in our previous article.

Concrete Roads.

ONE of the greatest difficulties encountered in constructing concrete roads is the provision of means for allowing for the contraction of the concrete on setting and for its alternate expansion and contraction under heating and cooling. If the road is constructed as a continuous sheet, comparatively wide cracks and warping soon occur. A system of concrete road construction which appears to overcome many of these defects is described

in a booklet recently sent to us by Captain D. G. McLea, of 68, Victoria-street. By this system the top layer of concrete is placed in the pockets of a steel meshwork, as shown by the accompanying engraving. The steelwork is formed from mild steel strip bent into short, zig-zag lengths, and held loosely in position by steel rods passed through holes pierced in the angles. This construction, it is claimed, offers no difficulty by expanding or contracting at its perimeter, and it is rigid enough to resist tension caused by the shrinkage of the setting concrete. When used for road-making, a lower course is first laid continuously; the steel mesh, having usually a thickness of about 3in., is next laid, and finally the concrete is set in the panels to a depth slightly greater so that any desired surface

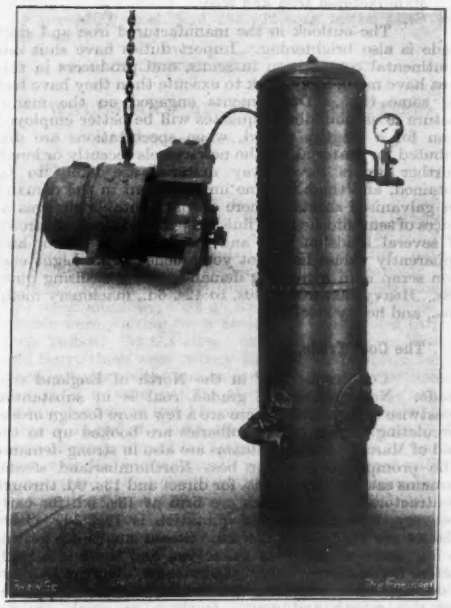
MCLEA CONCRETE ROAD CONSTRUCTION

finish may be obtained. For a 3in. upper course the panels would be 2in. deep and about 12in. square.

It is claimed that the small panels of the paving always rest on sufficient foundation; they are correlated by the metal structure as regards relative movement; the pockets of the structure keep them in horizontal relation, and the tie-rods passing through the panels in vertical relation to each other. We understand that the Ministry of Transport has under observation sections of concrete road built in this manner up to 6in., 7in., 8in., and 9in. total thickness, with paving courses ranging between 1½in. to 3in.

A Motor-Compressor Unit.

THE accompanying engraving is interesting as showing what perfect balance can be attained in machinery nowadays. Suspended from a crane there is a small



4½ H.P. MOTOR-COMPRESSOR UNIT AND AIR TANK

motor compressor unit delivering 25 cubic feet of free air per minute against a pressure of 100 lb. per square inch while running at 900 r.p.m. The compressor is a two-cylinder machine driven by a 4½ H.P. motor, and several sets have just been finished by Reavell and Co., Ltd., of Ipswich, to the order of the London and North-Eastern Railway for pressure brakes of electric trains. The clearness of every detail in the original photograph demonstrates the lack of vibration or movement when the machine is running.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

MUCH of the interest of industrialists this week is centred in the heavy section of the British Industries Fair at Castle Bromwich, and there the majority of Midland and Staffordshire engineers and iron and steelmasters were to be found. They have engaged in conversations with users and potential consumers of their products in an endeavour to discover the probable trend of trade during the coming months, and the possibilities of increasing output. On the whole, a confident spirit is maintained, though portents of industrial revival are not easily discernible. It is sincerely believed, however, that the Fair will give a fillip to many of the industries of the district, and that suppliers of material will benefit, in company with manufacturers. On 'Change in Birmingham business has been extremely quiet, though there have been many visitors from distant parts crossing the floor during the week. Current industrial activity in this area is very much on a par with what it has been during recent weeks. In some instances there has been a falling away of output, but in others there has been a compensating increase. The market position has undergone no important change, and selling prices are, for the most part, unchanged on the week. The Continental situation is being closely watched, and opinion is divided as to the ultimate success of the cartel revival. Midland iron and steelmasters are inclined to the view that competition from the Continent in the immediate future is likely to be less severe than it has been of late. Engineers and other consumers of foreign iron and steel appear to be paying more attention to local supplies, and inquiries are in circulation which suggest that they contemplate placing orders, which formerly have been given to Continental firms, with native producers. The usual spring revival in trade has not yet made its appearance, but it is felt that it will not fail to develop in the near future. Midland industrialists are fully equipped and ready to deal with whatever volume it may reach, and they await its unfolding with an assurance founded on courageous hope.

The Chain Trade.

Is the Black Country chain trade a dying industry? Will it be able to survive in face of the advance of science? These questions are occupying the minds of those engaged in the industry here, and, unfortunately, there is much evidence which points to the ultimate eclipse of the hand-hammered chain trade. Quite a number of manufacturers subscribe to the view that the industry is dying, and will never revive to any great extent. The introduction of machine-made chains has had a serious effect upon the hand-hammered branches of the trade, but, until recently, only the small sizes of chain were affected. Now it is claimed that cables can be successfully made by machinery, and if further progress is made in this direction, another branch of the trade will suffer. Fortunately, there are still a few customers who pin their faith to hand-hammered chain, and small orders are occasionally received, but whether this more expensive process of making chain will continue to hold its own against the inventions of science, remains to be seen. Many employers, as intimated above, are doubtful and feel that, like the old nail trade, the hand-made chain industry will gradually pass out of existence. At date works are very short of orders, and while hopes of improvement are held, the outlook for the industry is unsatisfactory.

Steel.

That branch of the market dealing with steel affords at the moment the chief source of interest, though, unfortunately, it is not on account of better demand. It is accounted for mainly, if not solely, by the negotiations proceeding amongst competitors abroad and by the action of merchants in quoting higher selling prices for Continental material. The uncertainty as to the successful re-establishment of the Internationl Steel Cartel is reflected in the market. Buyers are awaiting further developments before coming to a decision as to the advisability of transferring their custom to district mills. They are, however, making cautious overtures without definitely committing themselves. Sellers of foreign steel are further raising their quotations. In some instances values have advanced as much as 6s. per ton since the beginning of the month. Merchants quote small steel bars at £6 1s. to £6 2s., joists £5 13s., angles £5 17s. 6d. to £6 2s. 6d., plates £7 5s. to £7 10s., Belgian No. 3 bars £6 5s. to £6 10s. Finished products still come within the range of competition, but billets are actually dearer than those obtained from local works. In this case the result has been that British steel works have secured orders which otherwise would have gone abroad. English billet makers are, however, insisting upon higher prices. Quotations at Birmingham this week for imported consignments are £5 2s. 6d. to £5 7s. 6d. English billets have firmed up, the reason given being the stiffening of raw material costs. Mills now require a minimum of £5 for lots of 500 tons. For smaller lots, the graduated scale remains as before—100 to 250 tons, £5 5s.; under 100 tons, £5 7s. 6d. While there is a little more business being done in native steel, negotiations for Continental supplies have practically ceased. The orders being given out and the inquiries in circulation are for small tonnages. Consumers cannot be induced to purchase more steel than they actually require for current consumption. Structural engineers are very short of work and their requirements are few. The higher prices which are being demanded for Continental finished steel may divert a certain amount of business on the coast, but nothing appreciable in this district, where the principal buyers are committed to the home producer through the rebate scheme. Very few of the local steel mills are able to roll continuously. Special steels used in the motor industry are selling fairly well. Billet makers and the re-rolling trades are getting some little stimulus, but the latter are not so busy as they were two months ago. Finished steel prices are unchanged on the week, while values of steel semis, except in the instance noted above, are likewise unaltered.

Pig Iron.

Midland pig iron producers are obliged to stock some of their output owing to the falling off in specifications. Some of the important buyers are off the market, having covered their requirements for some months ahead. The persistent inactivity in most of the engineering branches stands between the heavy foundries and recovery, while the light foundries are doing very little to prepare for the revival which the spring is expected to bring, but which has not come yet. While there is hope of improvement in the light castings department, there seems little prospect of any change for the better in the heavy branch. There is no incentive for the consumer to buy now more than enough raw material to carry on. He is made aware by the urgency with which he is approached for orders that productive capacity is in excess of consumption. He has no fear of a shortage and is cognizant of the fact that he can get almost immediate delivery of any quantity of material should he suddenly require it. Blast-furnacemen are holding to the scale of charges laid down by the Central Pig Iron Producers' Association, which are on the basis of £3 2s. 6d. for Northamptonshire No. 3 foundry, £2 17s. 6d. for forge, and £3 6s. for Derbyshire No. 3 foundry, with £3 1s. for forge. These prices are for delivery at Black Country stations.

Finished Iron.

Although there is no actual or tangible change on the week in the demand for Staffordshire brands of finished iron, or any clearly discernible improvement in the trade position, the market tone is brighter. Maybe this can be attributed to anticipations of better business as a result of the B.I.F. It is probably felt that makers of manufactures of iron are sure to get some substantial orders, and that, as there are practically no stocks in the works, orders for finished iron must immediately follow the receipt by the manufacturers of orders for their goods. Customers this week have acted with the now customary caution when giving out specifications, and these have generally been for small quantities. No new movement is noticeable in any branch of the market, though the nut and bolt and other consuming industries in this district are slightly better engaged. Rollers of iron strip are still unable to make full time, but some of them are doing five days a week. Selling prices of Staffordshire finished iron are unaltered. Marked bars make £12 per ton at makers' works. Crown quality bars vary from £8 12s. 6d. to upwards of £9, nut and bolt bars are quoted £8, fencing bars £7 15s., and wrought iron tube strip £10 7s. 6d. to £10 10s. delivered.

Galvanised Sheets.

The galvanised sheet trade continues to make progress in the export markets. It is an uphill fight, however, against Belgian competition. In the home trade quiet, but regular, and not altogether unsatisfactory, conditions rule. There is no change in selling prices, either on home or export account.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery Exports.

A POOR start has been made with the year's export trade in textile machinery, for the January shipments were appreciably below the level of those of twelve months ago, both in quantity and value. Last month's exports totalled 4307 tons, valued at £398,376, compared with 5911 tons and £523,202 in January of last year, and 4898 tons and £515,858 in the corresponding month of 1931. The shipments during the period under review included 2828 tons of spinning and twisting machinery, of the value of £262,566 and 1157 tons of weaving machinery, valued at £80,126. Under the circumstances it is not surprising that exports to virtually every market were below the level of those of a year ago, the only exceptions being the United States and Australia. British India continues to occupy the leading position among the export markets in this class of British engineering product, the value of the exports thence amounting to £142,224. China occupied a poor second place with shipments valued at £34,586, followed by South America, £23,990; the United States, £23,853; Australia, £17,119; Japan, £15,190; Germany, £13,960; the Netherlands, £12,864; and France, £12,343. Export business with Russia would appear to be at a standstill for the time being, for the January exports of textile plant amounted only to 2 tons, valued at £1016. Shipments to "other European countries," were valued at £81,571, compared with £121,591 a year ago.

Oil-engined Omnibus Economies.

Economies achieved through the adoption of the oil-engined omnibus are emphasised by Mr. R. Stuart Pilcher, the manager of the Manchester Corporation transport department. Mr. Pilcher states that although the department has been faced with enormous difficulties in working the oil-driven motor omnibuses, most of them have been overcome and the saving in running costs every week amounts to the equivalent of the value of one new oil engine. There are fifty-two oil-driven omnibuses in service in Manchester, and the records of the transport department show that the weekly running costs are £103, compared with £580 which would be spent on a similar number of omnibuses running on petrol. The difference, Mr. Pilcher states, is sufficient to buy a new oil engine a week.

Industrial Results.

Substantially improved financial results have attended the past year's trading operations of Mather and

Platt, Ltd., electrical and mechanical engineers, of Newton Heath, Manchester. For 1932 the net profit of the company, excluding a profit of £27,810 on the sale of investments, amounted to £106,978, compared with £76,124 in the previous year. The dividend on the ordinary share capital is unchanged at 6 per cent., but the sum of £27,000 is transferred from the 1932 profit to the reserves, against nothing in the previous year. The manufacture of machinery for the canning industries is one of the latest developments of the company. The report for 1932 issued by Crossley Bros., Ltd., gas and oil engine manufacturers, of Openshaw, Manchester, states that a new type of marine engine upon which research and experimental work has been in progress for some years has now been completed, and that sales have begun. The company's accounts show a loss of £30,534 on the twelve months' working, compared with one of £59,672 in the previous year.

Non-ferrous Metals.

In most sections of the non-ferrous metals market during the past week the demand has been very moderate, but, on the whole, there have been no important changes in the price position. Standard copper has reacted a little, current values being between 2s. 6d. and 5s. per ton lower on balance for the week, whilst refined descriptions of the metal have also lost ground to some extent. Buying interest has only been on relatively quiet lines. Tin, likewise, has shown no improvement so far as actual business is concerned, and values have further weakened by about 15s. per ton. If anything, the lead section has been a little more active than of late and the previous week's loss of about 5s. per ton has since been recovered. There has been only a moderate inquiry about for spelter, but the undertone in respect of this metal appears to be improving slightly, a further fractional improvement in quotations bringing the prices current at the moment of writing almost exactly back to where they were at the end of January.

Iron and Steel.

Heavy and cheap supplies of machinery scrap available in Lancashire continue to press heavily upon the foundry iron market in this district, the consumption of the latter material being seriously affected. In spite of this, however, it is doubtful if the position is any worse in this respect than it has been so far this year. New business in pig iron is largely a matter of parcels for early delivery, and contract buying of any importance is still markedly absent. Values, however, are well held at 67s. per ton for Staffordshire, Derbyshire, and Cleveland brands of No. 3 iron, 65s. 6d. for Northants, 62s. for Derbyshire forge, about 82s. for Scottish foundry, and 80s. 6d. for West Coast hematite, all delivered to works in the Manchester district. Disappointing accounts are given of the trade in finished iron, but there has been no alteration in values, Lancashire best bars being quoted at £10 5s. per ton and Crown quality material at 10s. less. Whilst little or no improvement in the demand for heavy steel materials can be reported, especially for the constructional side, buying of special steels, including tool qualities, has shown some measure of expansion during the past week. Acid and basic quality boiler plates continue to be offered at about £8 10s. per ton, with tank plates at £8 17s. 6d., frame plates at £9 2s. 6d., sections at £8 7s. 6d., joists at £8 15s., large-diameter bars at £9 7s. 6d., and small re-rolled bars at £6 15s. Quotations for imported materials on this market are largely nominal, although the tendency is again towards higher levels.

BARROW-IN-FURNESS.

Hematites.

There is no change in the general condition of the hematite pig iron trade of the North Lancashire and South Cumberland areas. Business shows no expansion whatever, and the whole of the demand can be met with the existing production, with two furnaces operating at Barrow, two at Millom, and one small furnace at Backbarrow. For the most part the make is going into use, a good proportion of the Barrow output being used in the adjoining steel converters. There is no life in the demand on Continental account. Stocks of iron are held to a considerable extent in various parts of the district.

Iron Ore.

The demand for hematite iron ore is mostly on local account and therefore restricted. On general account business is very slack.

Steel.

The activity in the steel trade continues. The chief output at Barrow is of steel rails and hoops, steel bars, and strips. Rails are still in quiet demand, on both home and overseas account. Castings are in moderate demand.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Optimism.

DESPITE the fact that output has not increased, and unemployment remains at a high level, optimism in regard to the immediate prospects of the local steel industry persists. To a large extent it is justified, for, in addition to work which will come to Sheffield as a result of recently placed naval contracts, it is expected that the British Industries Fair will bring substantial orders to the district. At present the trouble is that whilst orders are satisfactorily numerous, they are not for substantial quantities. A definite disinclination to place large contracts exists. The heavy engineering and machinery branches are having difficulty in maintaining their outputs, and for railway materials the demand is very poor, but the section devoted to special steels is fairly busy.

Strip and Valve Steels.

Products of a new industry for the Sheffield district are exhibited at the British Industries Fair by the United Steel Companies, Ltd., Sheffield. They are of lacquered steel strip manufactured in a range of fifty standard colours, with both gloss and matt finishes. This material, it is claimed, can be blanked, stamped, or perforated without the surface being chipped or flaked, and it may be widely applied in the boot and shoe-grindery trade, for buttons, medallions, and badges, cyclets, seals, toys, &c. Nickelled steel strip is also produced, and there are other forms of plated strip and of stainless steel in cold-worked forms. The Daniel Doncaster and Sons section of the United Steel Companies is exhibiting a new valve steel, which is a development of the older silchrome steel, having greatly increased strength at high temperatures and being highly resistant to the embrittlement which was a drawback to the older valve steels. There are also available steels capable of being machined at speeds of over 400ft. per minute, made by the Steel, Peech and Tozer branch of the Companies.

Drop Forging Developments.

Following the greater use of large and strong vessels, capable of working at high pressures and at high temperatures—such as forged drums for super-power station boilers and forged steel pressure vessels for use in chemical and oil-producing processes—there is a tendency towards the use of drop-forged steel valves instead of cast steel valves. This is the result of the necessity for valves which will withstand the increased pressures and the desire to obtain an increased margin of safety and reliability without having to increase the weight or size of the valve. The English Steel Corporation, Ltd., Vickers Works, Sheffield, is successfully manufacturing suitable valve bodies, covers, &c., as drop forgings.

Novel Hotel Features.

Some disappointment is felt locally as a result of the announcement by Mr. J. Massey, architect, of Sheffield, that it will be impossible to use stainless steel for the exterior casing of the huge Sun Ray Hotel, which is to be erected at Blackpool at a cost of £750,000. It was intended to cover the surface of the structure, including a tower rising to a height of 511ft., with stainless steel, which would have produced a striking effect, particularly under illuminations. But it has been discovered that regular washing of the surface of the stainless steel would be necessary to prevent dullness, and as this would be impracticable with such a large building, consideration is being given to the use of a pearly glass material of fine texture and wavy surface for the exterior casing. The general structure of this hotel will be of ferro-concrete. A rigid steel frame will be filled in with concrete cast *in situ*. The tower will be entirely separated from the main structure and will have its own separate foundations. The building will take about three years to construct, and about 14,000 tons of steel will be utilised. Stainless steel will be used for interior fittings, such as doors, hand rails, &c.

Moved to Sheffield.

First established at Bradford and then transferred to Douglas, Isle of Man, some years ago, the firm of E. B. Grandage has now equipped the Broadfield Tool Works, Heely, Sheffield, for the manufacture of taps, dies and other small tools. The business has been removed to Sheffield in order that the works shall be more accessible to customers and also to suppliers of steel, practically the whole of the raw material used in the manufacture of the Grandage taps and dies being Sheffield steel.

Government Contracts.

The firm of Moorwoods, Ltd., Sheffield, has obtained a contract from the Contract and Purchase Department of the Admiralty for the supply of wet steam ovens. Steam cooking apparatus is also to be supplied by O'Brien Thomas and Co., Ltd., Rotherham, to the War Office, and it is reported that many local stove grate manufacturers are busily employed as a result of increased activities in house building in the Sheffield district. To the War Office, table forks and spoons are to be supplied by Mappin and Webb, Ltd., Sheffield; and table knives by Sheffield Steel Products, Ltd., and Atkinson Brothers, Ltd., Sheffield.

Tools and Cutlery.

The improvement in the demand for general tools is fairly well maintained, and although exports in January were £10,000 less than in December, they were £18,000 more than in January of last year. Sheffield's safety razors and safety razor blades industry is still progressing, and the output of huge quantities of blades is requiring the production of substantial quantities of steel strip. For the first time, a Sheffield firm, Thos. Ward and Sons, Ltd., of Wardonia Works, has obtained the contract for the supply of safety razors and blades to the British Army. In past years local manufacturers have supplied British soldiers with the old type of razor, but never before has the War Office contract for the modern shaving equipment been placed in Sheffield. The firm of Morris Radnan, Ltd., razor blade distributors, Manchester, has placed an order with a Sheffield firm for 4,000,000 razor blades.

Important New Bridge.

At an estimated cost of £78,000, the new bridge over the river Calder at the south end of Kirkgate, Wakefield, is practically completed. It is about 330ft. long and carries two cantilever footways, one at each side. The distance between the parapets is 78ft., and there is a road width of 55ft. The new bridge is believed to have the longest flat span in the country, and one of its attractive features is the slenderness of the four supporting piers.

NORTH OF ENGLAND.

(From our own Correspondent.)

Ironworks Developments.

Two things are outstanding in the announcement that Dorman, Long and Co., Ltd., Middlesbrough, are reconstructing a blast-furnace at their Cleveland Iron and Steel Works, South Bank. Another furnace has been blown in at the Cleveland Works, while the present rebuilding is proceeding. In the first place, the new furnace will have its output capacity doubled, and, in the second, it will represent the very latest design in furnace construction. For many months Dorman, Long's have been investigating furnace design with a view to obtaining the most economical unit, having in mind the utilisation of as much Cleveland ironstone from their own mines as possible. They arrived at the conclusion that a mechanically charged furnace producing about 400 tons of iron per day was best for their purpose, and accordingly the combined opinions of their experts are to be embodied in the new furnace. The principal alterations affect the interior, the hearth diameter being increased from 12ft. to 16ft. The furnace top gear is modified, the stack will be water-cooled, and four gas take-offs will ensure a uniform gas flow. The furnace will be blown independently by a new turbo-blower fitted with constant volume control. It will take about eight months to complete the reconstruction. I understand that the work of modernising the steel plant at the Skinningrove Iron and Steel Works is well up to the schedule, and that operations will be resumed on or about March 6th. The works have been closed down since the beginning of November. Three of the four blast-furnaces will be put into commission immediately, as well as the steel-producing plant, rolling mills, and the firm's ironstone mine at Loftus. As a result, about 1000 men will be reabsorbed into employment.

Cleveland Iron Trade.

There is at the moment a marked progressive tendency in the iron and steel industry of this district. The pulse of the market is quickening. Not only are inquiries more numerous, but better sales of Cleveland iron have been negotiated, both in this area and in Scotland. Industrial needs are undoubtedly increasing, and it would appear that consumers are becoming convinced that nothing is to be gained by waiting. There is an absence of bulk buying, and business on a small scale predominates, but in the aggregate the volume is very satisfactory. As the consuming works are becoming better employed, much improved business is expected, and the outlook is of a promising character. Stocks are gradually being liquidated, and any further quickening in the demand would soon bring about the restarting of more blast-furnaces. For delivery to customers in the Teesside area, No. 1 Cleveland foundry iron is 65s., No. 3 G.M.B. 62s. 6d., and No. 4 foundry and No. 4 forge 61s. 6d. To customers within 50 miles west of Middlesbrough and extending from the Midlands to the Scottish border, delivery prices are 2s. above the foregoing figures, and buyers beyond that area are charged up to 6s. 6d. above rates named for local consumption. Delivery prices to the Glasgow area are based on No. 3 G.M.B. at 62s. 6d.

Hematite Pig Iron.

The East Coast hematite pig iron trade has developed greater activity, buyers evidently deeming it wise to acquire supplies before the market moves against them. Heavy sales are reported to Sheffield, the Midlands, and South Wales. A contract for 1500 tons for Japan, has also been arranged, while small transactions have been put through with Continental customers. Quotations are still in the region of 59s. for East Coast mixed numbers and 59s. 6d. for No. 1 quality.

Iron-making Materials.

Foreign ore business is almost at a standstill. The nominal price of best Rubio remains at 15s. 3d. c.i.f. Tees. Blast-furnace coke is abundant, and buyers are very backward. Sellers put good average qualities at 15s. 9d. delivered at the works in this area.

Manufactured Iron and Steel.

The outlook in the manufactured iron and steel trade is also brightening. Import duties have shut out Continental competition in semis, and producers in this area have much more work to execute than they have had for some time. Departments engaged on the manufacture of shipbuilding requisites will be better employed than for a lengthy period, when specifications are distributed for material for the new vessels recently ordered. Further orders for railway material are likely to be obtained, and there is some improvement in the demand for galvanised sheets. There are no quotable changes in prices of semi-finished and finished iron and steel. Scarcity of several kinds of iron and steel scrap is acute, and apparently values have not yet touched top. Light cast iron scrap is in increasing demand, and is realising quite 38s. Heavy cast iron is 40s. to 42s. 6d., machinery metal 45s., and heavy steel 40s.

The Coal Trade.

Conditions vary in the North of England coal trade. Northumberland graded coal is in substantial coastwise demand, and there are a few more foreign orders circulating. Most of the collieries are booked up to the end of March. Durham steams are also in strong demand. The prompt position for best Northumberland steams remains satisfactory at 14s. for direct and 13s. 9d. through contractors. Tyne primes are firm at 13s. 6d. for early delivery, and forward the quotation is 13s. 3d. Other classes are 12s. 6d. to 12s. 9d. Steam smalls are getting a fair share of trade at 8s. to 9s., and there is a fairly active home market for washed steams. On the Durham side large steams are 15s. 6d. to 16s., and well supported for this month and next. Durham gas coals are not meeting with the average winter trade, and new business is badly needed to absorb output and maintain production. Failing increased demand, many pits will have to face idle time. Present output is difficult to clear, even at the schedule minimum. Top grades are easily obtainable at 14s. 6d., and secondary descriptions at 13s. 6d. The bunker demand has now fallen off, and sellers are pressing best qualities on the market at 14s. to 14s. 3d. Seconds remain weak at 12s. 6d. to 13s. 3d. Gas coke is quoted steadily, but the pressure for supplies is not so keen, and the undertone is easier. Best kinds are at 18s. 6d. and vertical at 22s. Patent oven coke stocks are increasing and the demand is dull. Prices are easy at 15s., with superior brands 15s. 6d. to 16s.

SCOTLAND.

(From our own Correspondent.)

More Hopeful Outlook.

THOUGH business, speaking generally, is not moving with any great freedom, the outlook is a shade more hopeful. Shipyards show more interest, owing to recent contracts, and there are prospects of an improvement in the export of iron and steel materials to Canada. Prices of steel and iron maintain a firm attitude owing, in a measure, to the imminent completion of arrangements for the reconstitution of the International Steel Cartel for a further period of five years, and the upward tendency of Continental prices.

Steel.

Though orders are still light, there is now more movement in heavy steel for shipyard material, and it is fully expected that contracts for sections and plates will expand considerably in the near future. Makers of steel sheets are still fairly well booked in the lighter gauges, and fully anticipate developments with Canada for light, heavy, and galvanised sheets. Heavy and galvanised descriptions are very quiet at the moment. Tube makers have been comparatively well employed since the beginning of this year, until about a week ago, and there is a strong feeling that this quiet period will be a temporary one, the inquiry being still fairly well maintained.

Iron.

The market for bar iron remains dull, with prices unchanged. Re-rolled steel bars are in much the same position, but, with Continental prices on the up grade, makers are hopeful of securing a better share of the business on offer. Home prices are unchanged at £7 5s. for local delivery, and £6 10s. per ton export.

Scrap.

There has been a little more movement in scrap, and quotations are firmer round about 37s. 6d. to 40s. for heavy steel, and £2 10s. per ton for cast iron machinery.

Pig Iron.

Despite reductions in price, the demand for pig iron is still easily met from stocks, and the production is confined to two furnaces, one making foundry and one basic iron.

Oil Engines for Iraq.

It has just been announced that Harland and Wolff, Ltd., have secured an order for fifteen oil engines for the Iraq Petroleum Company, Ltd. The engines are to be of the four-stroke single-acting airless injection type and of 500 H.P. The construction will be carried out at the firm's oil engine shops at Finnieston, Glasgow.

Coal.

The feature of the market is the continued strength of screened fuels, especially in the East of Scotland, where some qualities are still difficult to obtain for early shipment. Foreign demands are still tight, importers abroad being disinclined to pay present colliery prices, while exporters are not prepared to take risks in view of the uncertainty existing under the quota system. Washed nuts are comparatively steady in all districts, the recent downward tendency of prices having been arrested and collieries now holding out for full current rates. Aggregate shipments amounted to 238,678 tons, against 245,190 in the preceding week and 262,492 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE conditions in the coal trade cannot be said to be good, except perhaps so far as they affect the western part of South Wales. The loading pressure at the ports of Swansea and Port Talbot, in which area industry generally appears to be better, is well maintained. This is shown by the dock returns which, at the beginning of this week, disclosed that all tips were engaged, while four vessels were waiting for a berth at Swansea and three at Port Talbot. At the steam coal ports between Newport and Barry there were twenty-three tipping appliances idle. These returns would not be considered altogether unsatisfactory if it were not for the fact that vessels are not getting loaded as quickly as usual, as so many of their cargoes consist of sized coals which are very scarce. The demand from abroad for large coals continues to be very slow, with the result that the production of sized qualities is restricted. Shipments of coal and coke from the six leading ports in this area last week came to 392,195 tons, which compared with 394,404 tons for the corresponding period of last year, last week's total being about 1000 tons less than for the preceding week. It almost looks now as if shipments are becoming stabilised round about just under the 400,000 tons mark per week, which, of course, means that many collieries are having a very slack time. Certainly, the foreign inquiry for coals leaves much to be desired, and really possesses no feature so far as orders for prompt loading are concerned, except that, for the first time for about twelve months, the Greek State Railways and Greek Royal Navy are in the market for three cargoes. Up to a year ago they almost regularly took supplies from South Wales, but since then they have been taking German coals. Now the Greek railways require prices for two cargoes of about 5000 tons each for delivery at Chalkis and Salonica, and the Navy's requirement is a cargo of about 4500 tons to be delivered at Salamis. Another inquiry is from the Thessalia Railways for a cargo of about 4500 tons of steam coals for delivery at Volo. Orders recently quoted for, such as that for 6000 tons of steam coal for the Palestine Railways to be delivered at Haifa, and another of about the same size for the Jamaica Railways, for delivery at Kingston, have been secured by local firms, but so far as new business is concerned for near Continental ports the conditions are very unsatisfactory.

Spain's Drastic Proposals.

Coalowners and coal exporters were in London last week to interview the Secretary of Mines concerning the severe proposals of Spain regarding coal imports. As a result a protest is being made to the Spanish Government, and it is very essential that the utmost should be done to prevent the proposals maturing, as South Wales stands to suffer most for the reason that 70 per cent. of the United Kingdom's coal exports to Spain are from this area. It will be recalled that towards the end of last year reports were current that Spain contemplated severely curtailing her coal imports at the behest of the Spanish coalowners. Since then a commission has been considering the coal situation generally in that country, and the proposals now submitted to the Spanish Government are more drastic than ever. One of the proposals put forward is that the proportion of Spanish coal that consumers are compelled to buy shall be increased by 15 per cent., but another proposal, which, on the face of it, is extremely menacing, is the establishment in Spain of an organisation to control the importation of all foreign coals. This organisation is described as a "Sales Bureau," which would be run in the interests of the Spanish colliery owners and operated by them, with the result that the Spanish coalowners would have entire control over the market and prices. The inevitable result of such a serious development would be that the importation of coals would be restricted to only such quantities and qualities as cannot be satisfied by native production.

Miscellaneous Items.

The Arrow patent fuel works at Newport, under the control of British Briquettes, Ltd., reopened this week after being idle for about two years. The demand for patent fuel has recently improved. Resumption of work means employment for about 100 workmen. The new blast-furnace at the Dowlais Works, Cardiff, belonging to the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., is expected to be completed and blown in at the end of this week. The furnace, which will be capable of producing 4000 tons of pig iron per week, has been in course of construction during the past twelve months, the foundations alone taking about six months to complete. Resumption of production will result in welcome employment for a number of men. The strike in the early part of last week of the workmen engaged at the Gwaun-Cae-Gurwen Colliery on the question of non-unionism did not last forty-eight hours. It was claimed that, as a result of the strike, the number of non-unionists was reduced from 277 to six. The men at the Bedwas Navigation Colliery came out on strike last week, their grievance being that the management had introduced into certain conveyor faces men who were not engaged at the colliery two years ago, this being in conflict with the agreement reached in 1931. The management has refused to meet a deputation of the workmen to discuss the situation until the men resume work. The Bedwas Workmen's Lodge has decided to ask the executive council of the South Wales Miners' Federation to earmark £20,000 to support the Bedwas workmen. About 750 miners at the Pentre Colliery, belonging to Cory Brothers and Co., Ltd., have received a fortnight's notice to terminate their employment. According to the general manager of this undertaking, the Pentre Colliery never lost a day through want of trade for twenty-five years up to 1930. This was prior to the passing of the 1930 Coal Mines Act, but since then the colliery has worked very irregular time, and closing down has been rendered inevitable. A good deal of criticism has, of late, been levelled at the operation of Part 1 of the 1930 Coal Mines Act, and in this district considerable interest is being displayed in the decision of Swansea collieries to go to arbitration over the refusal of the South Wales District Executive Committee under the Coal Mines Act to grant them a separate class and quota for coals of the manufacturing description produced by them. The owners desire a larger quota to meet the improved demand arising from the more active conditions prevailing in the tin-plate, iron and steel industries in that area. Arbitration is expected to take place about the end of this week, Mr. Trevor H. Hunter, K.C., being the officially appointed standing arbitrator.

Current Business.

Business continues on very quiet lines, and any orders that come on the market are soon fixed, as tonnage is on offer freely for all directions, and at rates of freight which are wholly uneconomic. Collieries have heavy stocks of most descriptions of large coals, but sized qualities and washed smalls are at a premium and very difficult to arrange for early shipment. Shippers to France, in most cases, exhausted their licences a week ago for cargoes this month, and so far as can be ascertained the import quota for coals into France for March is expected to remain at the same figure as for February, viz., 65 per cent. of the datum period. Coke finds a very steady demand, and patent fuel is well stemmed for the next week or two. Pitwood is quiet and remains about 19s. to 20s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE DRUM ENGINEERING COMPANY, Ltd., informs us that its London office address has been changed from 76 to 38, Victoria-street, S.W.1. Telephone number, Victoria 3190.

JAMES GORDON AND CO., Ltd., Windsor House, Kingsway, have appointed Tom Smith and Clarke, Ltd., Castle Buildings, Swansea, as their district representatives in South Wales.

STOTHERT AND PITT, Ltd., Bath, inform us, in connection with an announcement recently made by Messrs. Richter and Pickis, 6, Crescent, Minories, London, E.C.3, that an arrangement, whereby "Ricanpick" bucket ladder excavators were to be made solely by Stothert and Pitt, Ltd., Bath, has not been ratified by Messrs. Richter and Pickis' German principals. In consequence, Stothert and Pitt, Ltd., will continue to make bucket ladder excavators of their own design at their Bath works, independently of any association with Richter and Pickis.

G. R. BARCLAY, J. P. D. Coleman, and J. E. Oram, who have held responsible positions with Wild-Barfield Electric Furnaces, Ltd., for a number of years, have been elected to the board of that company.

CONTRACTS.

THE CAMBRIDGE INSTRUMENT COMPANY, Ltd., of 45, Grosvenor-place, London, S.W.1, has recently received an order from the Admiralty for twenty-four Cambridge recording and indicating electrical CO_2 meters to be installed in the Royal Naval Cordite Factory at Holton Heath.

PETER BROTHERHOOD, Ltd., Peterborough, has received, through its agents, The Middle East Development Company, Cairo, a contract from the Egyptian Ministry of the Interior for ice-making factories:—Aswan, 5 tons; Fayoum, 5 tons; Keneh, 7½ tons; Minia, 12½ tons; Zegazig, 12½ tons. The contract in each case consists of the erection of the building and the installation of the following plant:—Double-acting vertical ammonia refrigerating compressor driven by belt by a Harland three-phase 50-cycle slip-ring motor, complete with oil separator and liquid receiver and accessories.

LT.-COL. ALFRED HACKING.—The Council of the Society of Motor Manufacturers and Traders, Ltd., received, on Thursday, February 16th, the formal resignation of Col. Hacking. Reference was made by the President, Mr. Leslie Walton, and by Mr. E. H. Blake, to the services of Col. Hacking since 1922, first as Secretary and subsequently as Director of the British Manufacturers' Section. As a mark of appreciation a presentation was made to Col. Hacking. It included a bookcase of Lord Halsbury's "Laws of England" and a diamond wrist watch for Mrs. Hacking. Prior to the meeting of the Council an informal luncheon was held at which Mr. F. R. Simms and Sir Edward Manville presented to Col. Hacking a silver salver on behalf of all the Past Presidents of the Society and the members of the Finance Committee.

RECLAMATION OF THE ZUIDER ZEE.—The director of the Zuider Zee works (Mr. V. J. P. de Blocq van Kuffeler) has arranged to deliver on Friday, March, 3rd, in aid of King Edward's Hospital Fund for London, an illustrated lecture, describing the way in which this engineering achievement was carried out, under his supervision. The lecture will start at 5.30 p.m., at Drapers' Hall, Throgmorton-street, E.C.2, and the chair will be taken by his Excellency the Netherland Minister (Jhr. de Marees van Swinderen). Admission will be by ticket only. Tickets, 3s. reserved and 2s. unreserved, can be obtained either from the Secretary, King Edward's Hospital Fund for London, 7, Walbrook, E.C.4; or from Alfred Hays, Ltd., 74, Cornhill, E.C.2; 26, Old Bond-street, W.1; and 62, Strand, W.C.2; not at the doors.

THE ENGINEERS' GERMAN CIRCLE.—The second lecture of the present session of the Engineers' German Circle was held on Monday evening last, February 20th, at the Institution of Mechanical Engineers. The paper presented was read by Dipl.-Ing. E. Ernst Kugel, chief engineer of the Schloemann A.G., of Düsseldorf, who spoke on "New Developments in the Design of Rolling Mill Equipment." The paper was divided into three sections, and dealt with a typical modern bar and section mill, the description of the latest type of mechanical cooling bed with electrically operated rotating shears, and the design and construction of a modern continuous billet and sheet bar mill. Finally, the speaker described the newest developments in continuous wire rod mill practice, and illustrated a recent type of roll stand in which the rolls are driven by individual motors. The principal features of the paper were clearly illustrated by drawings, lantern slides, and cinema films, and the excellent delivery of the lecturer placed it among the best of the papers yet given to the Circle. After the meeting an informal dinner was held at the Anglo-German Club, 6, Carlton Gardens, which was also well attended.

EVEN BETTER SELLING.—"Even Better Selling" is the name of a pamphlet devoted to "even better selling" at our trade fairs and exhibitions, which has been compiled, at Sir Francis Goodenough's suggestion, under the auspices of the Incorporated Sales Managers' Association, as a service to the salesmen who are responsible for the successes of trade fairs and exhibitions, but who, until now, have had no special manual of instruction on the difficult task of capitalising the particular advantages of fairs and exhibitions. This manual has been prepared by Harold Whitehead and staff, an organisation which has done much important staff training work and which is now working for the Government in the development of the Post Office Telephone Service. An advisory committee of experienced sales managers was appointed by the Association to work with Harold Whitehead and staff, and, in addition, a small committee of important exhibitors from previous British Industries Fairs has also placed the benefit of its experience at the disposal of the authors. The manual is offered to exhibitors at the nominal price of 2s. each, and can be obtained from the Incorporated Sales Managers' Association at 101, Great Russell-street, W.C.1.

INSTITUTE OF MARINE ENGINEERS.—The annual dinner of the Institute of Marine Engineers was held on Friday evening last, February 17th, when a large and representative gathering of well over 500 members and guests assembled at the Connaught Rooms. The President, Commander C. W. Craven, R.N. (Ret.), took the chair. The toast of "The Shipbuilding and Engineering Industries" was proposed by Sir George Higgins, Chairman of Lloyd's Register of Shipping and the President-elect of the Institute. Sir George paid a tribute to the way in which shipbuilders and marine engineers had kept up to date during a period of intense depression, and said that he now trusted that the worst was passed and that things were on the mend. The shipbuilding figures for the first few weeks of the present year were encouraging, and Sir Joseph Isherwood's invention of a new form of hull, giving a thoroughly economical ship, was an important event. Sir James Lithgow, responded, and referred to the difference of standards of living in the shipbuilding and engineering industries and the sheltered trades. Shipbuilding could not thrive whilst those engaged in it were condemned to lower wages than those engaged in the domestic work of the country, and it was further handicapped by high taxes and high costs. Mr. Lewis Noad, K.C., gave the toast of "H.M. Dominions Overseas and the Mercantile Marine," and referred to the quiet heroism of the marine engineers he had come in contact with during his experience of salvage work. In his reply, Sir Henry H. Barwell said that the remedy for many of the present ills was to increase inter-Imperial trade. The health of the Chairman was proposed by Mr. F. E. Rebbeck, a Past-president, and was enthusiastically honoured. The speeches were interspersed with musical items, and an enjoyable evening was spent.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
(f) Cleveland—		
No. 1	3 5 0	3 1 0
Siliceous Iron	3 5 0	3 1 0
No. 3 G.M.B.	3 2 6	2 18 6
No. 4 Foundry	3 1 6	2 17 6
No. 4 Forge	3 1 0	2 17 0
Mottled	3 0 6	2 16 6
White	3 0 6	2 16 6
MIDLANDS—		
(e) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	8 12 6 to 9 5 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton	10 0 0
	Lots and Upwards Delivered Glasgow Stations.	
„ (Gal. Cor. 24 B.G.)	For Canada separately arranged	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	7 12 6 to 7 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 12 6 to 6 17 6	—
Billets and Sheet Bars	5 0 0 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/3
Block Tin (cash)	148 5 0
„ (three months)	148 10 0
Copper (cash)	28 7 6
„ (three months)	28 12 6
Spanish Lead (cash)	10 10 0
„ „ (three months)	10 15 0
Spelter (cash)	13 18 9
„ (three months)	14 2 6
MANCHESTER—	
Copper, Best Selected Ingots	32 7 6
„ Electrolytic	33 5 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11½
Lead, English	12 5 0
„ Foreign	11 2 6
Spelter	14 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c. unit	£13 10 0 scale 5/- per	
„ „ 75 p.c. unit	£19 10 0 scale 6/- per	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	15/6
„ „ Splint	15/9 to 16/3
„ „ Trebles	14/6
„ „ Doubles	11/6
„ „ Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
„ „ Jewel	16/6
„ „ Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Unscreened Navigation	13/- to 13/6
Trebles	14/9 to 16/-
Doubles	12/6 to 13/3
Singles	10/6 to 10/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/-
Secondary Steam	13/6
Trebles	15/-
Doubles	12/-
Singles	10/6 to 10/9

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.	Export.
Best Hand-picked Branch	27/- to 28/-	—
South Yorkshire Best	23/- to 24/-	—
South Yorkshire Seconds	18/- to 21/-	—
Derbyshire Best House	22/- to 23/6	—
Derbyshire Best Brights	18/- to 20/-	—
Screened Seconds	17/6 to 19/-	—
Kitchen Coal	16/6 to 17/6	—
Best Screened Nuts	17/- to 18/6	—
Small Screened Nuts	16/- to 16/6	—
Yorkshire Hards	17/- to 18/-	—
Derbyshire Hards	17/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—

Blast-furnace Coke (Inland) 10/- on rail at ovens

Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

CARDIFF— (9) SOUTH WALES.

Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	15/6 to 16/6
Patent Fuel	22/-
Pitwood (ex ship)	19/- to 20/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	36/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/- to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations. (*f*) Delivered North-East Coast.

French Engineering Notes.

(From our own Correspondent in Paris.)

Commercial Treaties.

In a conference last week before the Comité d'Action Economique et Douanière, Monsieur Elbel, Director of Commercial Arrangements at the Ministry of Commerce, explained the methods pursued by the Government to adjust trade conditions with other countries by modifying treaty arrangements that were carried out during the prosperous years preceding the world collapse. As soon as France was overtaken by the crisis, the onerous character of those treaties became manifest, and there appeared to be no alternative but to secure full liberty for the adjustment of tariffs, and, consequently, a suppression of the most-favoured-nation-treatment clause. An attempt to compromise with Germany met with only partial success. That country refused to relinquish the most-favoured-nation-treatment, except for a limited number of articles in which she had no interest whatever, and this qualified result is regarded by Monsieur Elbel as making at least a breach in the most-favoured-nation principle, which he hopes to widen by negotiations with other countries. Nevertheless, he admits that it will be difficult to overcome the resistance of countries like Belgium and Switzerland, which, for quite different reasons, hold tenaciously to the clause. A certain liberty in tariff arrangements was also agreed upon with Germany, whereby the duties on any particular goods could be raised by one country on the condition that two weeks' notice should be given to the other, which would then have the option of raising duties similarly on other goods in order to preserve the trade balance. Germany has been the first to take advantage of this privilege, and has notified France of an increase in the tariffs on a certain number of goods and products. France is now negotiating with Germany in the hope of reaching some compromise. The system appears to have the effect of strengthening Protection and reducing exchanges, which is not what the French sought to obtain. Monsieur Elbel has been engaged with the French Committee at Geneva in preparing a programme for the French Government in view of the forthcoming World Economic Conference. In his address he presented a dismal view of the situation. If the downward curve of foreign exchanges continues in the way it is doing at present, it will, he says, reach zero in less than two years. Foreign trade will then have vanished altogether. Monsieur Elbel dealt with the complexities and difficulties of the problems to be solved at the World Conference, and he affirms that the French would have to make industrial sacrifices, for it was hopeless to expect that France could become self-supporting with her colonies. A future adjustment of exchanges, he said, can only be effected by a "give-and-take" policy with a moderate system of tariffs.

Tax on Imports.

The French acceptance of the plea that trade can only be restored by a suppression of import quotas and a reduction of tariffs is negatived by the financial necessity of increasing the State revenue, and amongst the new taxes proposed by the Chamber, and approved of by the Senate, is one on import licences. The amount of the tax has not yet been fixed, but, in view of the revenue provided for, it will represent a substantial addition to the import duties. The tax will be paid by holders of import licences, who might be tempted to pass it on to the consumer, and thereby increase the cost of commodities. The Chamber of Deputies expects to avoid this risk by fixing maximum selling prices of products imported under quotas. The idea of imposing this tax is that licence holders can very well contribute something out of their alleged abnormal profits. As a matter of fact, the tax will only open the way to combinations that must inevitably put the burden on the consumer. Import quotas constitute a limited monopoly to foreign producers, who are able to sell in France at prices higher than the competitive prices prevailing in other countries.

Proposed New Battleship.

The programme of naval construction provides for the putting in hand this year of four cruisers of 7500 tons, but the building of these vessels is being held up by a proposal to replace them with a second battleship of the "Dunkerque" type. The arguments in favour of this substitution are that the 10,000-ton cruisers have already been outclassed by the German battle-cruisers and that the lighter cruisers would be helpless against the Italian cruisers, which would be practically equal in speed and much more powerfully armed. Therefore the Conseil Supérieur de la Marine is believed to regard the battleship as offering the only chance of security against the modern cruisers, and the Minister of Marine has suspended the putting in hand of the 7500-ton cruisers in view of a proposal to be presented to Parliament for the construction of a second battleship. The cut in naval as well as in other expenditure, necessitated by the enforced national economy, has strengthened the arguments in favour of the battleship, the construction of which would effect a saving of 400 million francs, as compared with the building of the four light cruisers.

Colliers.

Before the war there were no French boats engaged in the coal-carrying trade. During the hostilities as many vessels as possible were employed for the purpose, and they subsequently helped to constitute a fleet that continued in activity until about two years ago, when it succumbed to the coal import restrictions and to foreign competition. The owners of these colliers declare that 400,000 tons of vessels are laid up, with little hope of being put into service unless the Government does something to remove the disabilities that paralyse them in the way of restrictive legislation, high charges, and the eight hours' working day. French colliers carry only about 28 per cent. of the coal imported into France. The late Minister of the Merchant Marine announced his intention of making the issue of import licences conditional on a larger percentage of coal being carried on French vessels, but nothing so far appears to have been done in this direction. Every move of this kind is followed by unexpected and sometimes dangerous consequences.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

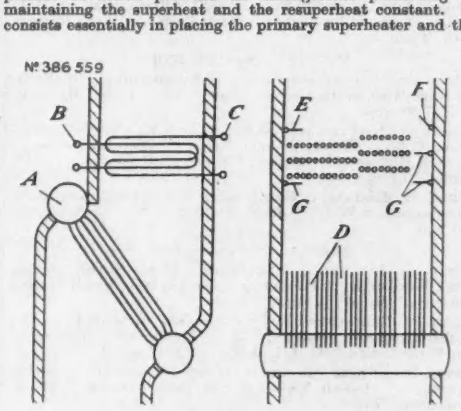
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

386,559. July 8th, 1932.—SUPERHEATERS, Société Alsacienne de Constructions Mécaniques, Mulhouse, Haut-Rhin, France.

This invention relates to steam generator or boiler furnaces which include a primary superheater and a secondary superheater. When steam at very high pressure is used for driving engines or steam turbines, it is very desirable in order to obtain the maximum thermal efficiency to resuperheat the steam after it has already done work in one part of the engine, or steam turbine. One of the means of superheating or secondary superheating is to return the steam to the boiler in which it is passed through coils heated externally by the combustion gases. In lieu of returning the expanded steam to the boiler, it may be reheated by means of live steam which, after cooling, is again returned to the boiler for a second superheat. Thus, the boiler includes a primary superheater and a secondary superheater. In order that the operation of the boiler should be satisfactory, it is necessary that the temperature of the steam leaving the two superheaters should be practically constant, whatever the load on the boiler. It is necessary that the steam should leave always at a temperature such that the materials used will not be brought to an excessive temperature having regard to their strength. Experience has, however, shown that without special precautions the temperature of the steam leaving the superheater or resuperheater increases with the load. Various means have been utilised; *inter alia*, the injection of water into the steam to cool it and to bring it back to the temperature which it is calculated should not be exceeded. The present invention provides an arrangement permitting of maintaining the superheat and the resuperheat constant. It consists essentially in placing the primary superheater and the

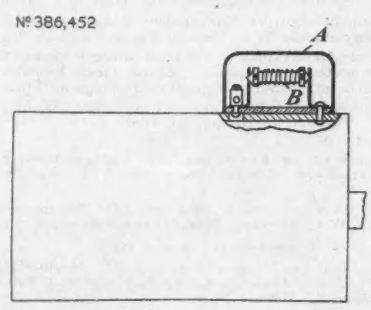


secondary superheater at the same region in the path of the gases, exposing them both to the radiant heat of the furnace and to the convection heat of the gases, and providing dampers or baffles permitting of excluding as desired a part of one or other of the superheaters, or of both, from the heating action by the gases in order to regulate the final temperature of the steam in each of the heat exchangers. It is known, in fact, that a superheater exposed only to the radiant heat of the furnace gives a superheat temperature which decreases when the load increases, and that a superheater exposed only to convection heat of the gases gives a superheat temperature which increases when the load increases. By combining the effects of radiant heat and of convection heat a practically constant superheat may be obtained. In the drawing, A indicates the steam and water drum, B the primary superheater, and C the secondary superheater. These two structures are located behind the first bank of tubes of the boiler. This bank provides gaps D unoccupied by tubes by which the radiant heat emanating from the furnace may reach the superheaters. A suitable width of these gaps is intentionally selected. A pivoted baffle E, for example, shown in its extended position, causes the gases to pass certain tubes and, consequently, gives rise to less superheat. This baffle or damper may be located as shown at F, so that when it is open the gases pass directly by way of a lateral passage and, consequently, reheat the tubes to a less extent. These baffles are preferably arranged beyond the superheaters, an arrangement which is favourable to the life of the baffles, but they may be placed also beneath the superheaters, as indicated at G G.—*January 19th*, 1933.

DYNAMOS AND MOTORS.

386,452. February 6th, 1932.—DYNAMOS FOR VEHICLES, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

Variable-speed dynamos for charging the batteries on motor vehicles have usually been of the type employing a

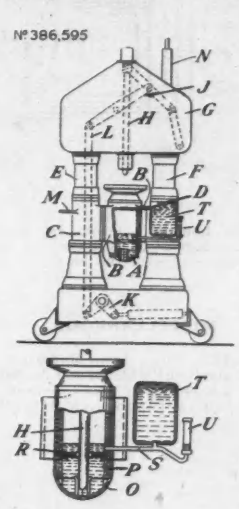


voltage regulator involving extra parts, or of the three-brush type, in which case it is usual to arrange a resistance in the field winding circuit. These resistances have hitherto been permanently mounted within the machine, and variation of output is, therefore, not generally possible, although in certain cases, two resistances have been controlled by a change-over switch. According to the invention the field resistance is mounted external to the dynamo as a detachable and interchangeable cartridge unit. After removing the protective cap A, the fuse B, which can have a resistance of, say, 0·5 ohm, can be easily exchanged for another fuse, which may have a negligible resistance. The new fuse is, therefore, suitable for use in winter, as the dynamo must then yield its full output.—*January 19th*, 1933.

SWITCHGEAR.

386,595. August 31st, 1932.—HIGH-TENSION ELECTRIC SWITCHES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C.2.*

The illustration shows a single-phase switch, constructed in accordance with the invention. For three-phase work three single-phase switches of this type form a unit. A is an extinguishing chamber provided with brackets B. Above the pillars C and D there are insulators E and F, which are connected to one another by a casing or headpiece G, on which the moving contact H and its drive J are mounted. This drive is connected to the bell-crank lever K in the base plate by an insulating operating rod L, which passes through the insulator E, and the pillar-shaped part C. M and N are the connections.

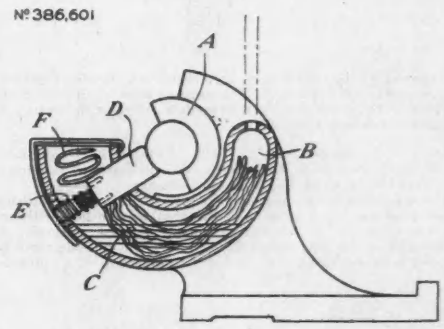


The explosion chamber consists essentially of a pressure-resisting metal casing O, lined with insulating material P, which extends above the explosion chamber in the form of a collar. The explosion chamber has a dividing partition R below the liquid level, and is provided with an opening for the passage of the moving contact H. Below the normal liquid level a tube S is connected with the storage vessel T. If, in consequence of the generation of vapour on operating the switch, the liquid level in the chamber falls to such an extent that the opening of the tube S is no longer covered, liquid will be expelled from the vessel T until the liquid level in the explosion chamber has again risen to such a point that the opening of the tube S is covered by the liquid. The liquid level in the chamber itself is indicated by means of a gauge glass U.—*January 19th*, 1933.

TRANSMISSION OF POWER.

386,601. September 15th, 1932.—BEARINGS FOR HIGH-SPEED SHAFTS, F. Delepierre, 57 Rue Clarisse, Haubourdin, France.

This bearing is specially applicable to the drum axles of spinning mules. It comprises a half brass A, which is arranged in such a position that it faces the resultant pull on the shaft



caused by the tension in the belts and the force of gravity. Beneath the brass there is an arc-shaped oil-box B, in which there is a wick C. This wick supplies oil to a felt pad D, which is pressed up against the shaft by the spring E. The ribbon F provides an easy means of withdrawing the wick and pad.—*January 19th*, 1933.

FURNACES.

386,387. November 10th, 1931.—WINDING FOR ELECTRICAL INDUCTION FURNACES WITHOUT A CLOSED FERRO-MAGNETIC CIRCUIT, Allmänna Svenska Elektriska Aktiebolaget, of Västeras, Sweden.

Various means have been proposed to equalise the current distribution in the primary winding of electrical induction furnaces without a closed ferro-magnetic circuit, the current distribution of which otherwise has a tendency to get extremely uneven on account of the large leakage inductance. The invention relates to a simple and efficient arrangement for this purpose. A is the crucible and B the charge, both assumed to be cylindrical. The furnace winding C consists of six concentric cylindrical winding sections, of which the five innermost sections D consist of flat copper, wound edgewise, while the outmost section E consists of tube-shaped conductors, which may serve the purpose of conducting a cooling medium. The different sections can be connected according to Fig. 2, *i.e.*, so that only one section, for instance, the outmost one E, is connected to a generator F, preferably in series with a capacity, which compensates the self-inductance of the generator, while the other sections are each connected to a condenser shown at H to J by means of switches K–L, so that a larger or smaller number of the sections can be put into operation. The winding E substantially carries only the active component of the furnace's

primary current, while the other winding sections exclusively carry reactive currents produced by the condensers. As the reactive power consumption generally increases during the melting of the charge, more winding sections with corresponding

Nº 386,387

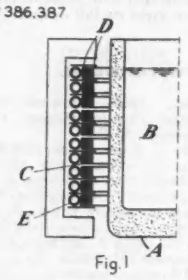


Fig. 1

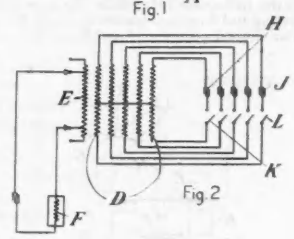


Fig. 2

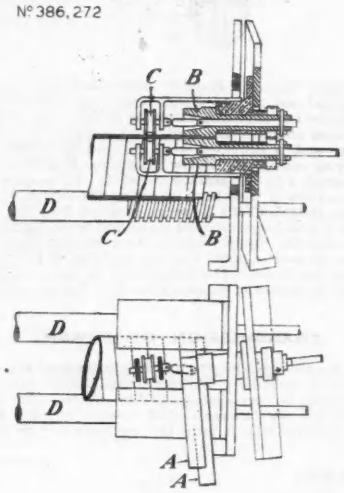
condensers may be gradually connected in circuit during such melting. It is recommended to start with the innermost sections and to continue with the outer sections.—*January 19th*, 1933.

MISCELLANEOUS.

386,272. August 19th, 1932.—TUBE MAKING, G. S. Spalding, 681, Ecclesall-road, Sheffield, 11, and A. Midgley.

Tubing is made, according to this specification, by coiling, helically, two overlapping strips of metal A A. These strips are

Nº 386,272

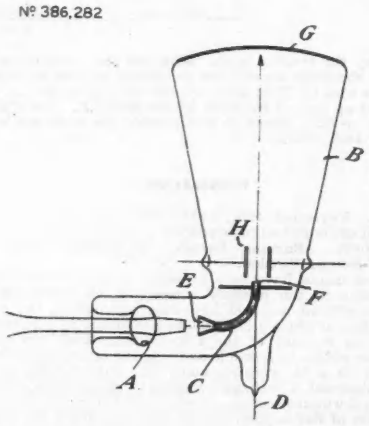


fed forward by the rolls B B and are electrically welded together by the roller electrodes C C. The finished tube is supported by the rolls D D, which are screw-threaded, to assist in feeding it forward.—*January 12th*, 1933.

386,282. September 24th, 1932.—ELECTRON DISCHARGE TUBES, Allgemeine Elektricitäts-Gesellschaft, of Friedrich Karl-Ufer 2/4, Berlin, N.W.40, Germany.

This invention relates to a device which permits of the shifting of an electron beam from one direction to another, without the employment of magnetic fields. A hot cathode A is enclosed in the bent vessel B. Opposite the cathode there is a small bent metal tube C. On the application of a suitable

Nº 386,282



voltage to the tube by means of the lead D, the electrons emitted by the cathode are directed into the opening E of the tube. The direction of the ray of electrons corresponds to the dot and dash line, and may be made visible by means of the fluorescent screen G. The direction of exit of the ray thus deviates considerably from the original direction in which the ray enters the tube, and may be acted upon electrostatically, by means of deflecting plates H.—*January 12th*, 1933.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF ELECTRICAL ENGINEERS: N.E. CENTRE.—Armstrong College, Newcastle-upon-Tyne. Debate, "Electric *versus* Diesel-electric Locomotives," Mr. D. C. Plyer and Mr. P. Richardson. 7.15 p.m.

INST. OF MUNICIPAL AND COUNTY ENGINEERS.—Metropolitan District meeting at Wandsworth, Clapham Baths, Manor-street, High-street, Clapham. 6.30 p.m.

INST. OF PROFESSIONAL CIVIL SERVANTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Air Photography and Archæology," Mr. O. G. S. Crawford. 5.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Smoke Detection and Measurement," Major C. E. Prince. 7.30 p.m.

KEIGHLEY ASSOC. OF ENGINEERS.—Queen's Hotel, Keighley. Ladies' night. Lecture by Mr. Allan Butterfield. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "The Water-tube Boiler and the Cargo Ship," Engineer Rear-Admiral W. M. Whayman and Major W. Gregson. 6 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, "Photographic Analysis of Explosion Flames," Professor W. A. Bone. 9 p.m.

SATURDAY, FEBRUARY 25TH.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Visit to works of the Premier Electric Welding Company, Orchard-street, Newcastle-upon-Tyne. 2.30 p.m.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—Visit to British Industries Fair, Castle Bromwich.

INST. OF MUNICIPAL AND COUNTY ENGINEERS: S. EASTERN DISTRICT MEETING.—Assemble Council Offices, Purley. 11 a.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1.—"Detection and Production of Swift Particles," Lord Rutherford. 3 p.m.

MONDAY, FEBRUARY 27TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Salvage Work on Ex-German Fleet at Scapa Flow," Mr. E. F. Cox. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: N.E. CENTRE.—Armstrong College, Newcastle-upon-Tyne. "Post-war Developments in High-pressure Boilers," Messrs. C. H. Davy and C. H. Sparks. 7 p.m.

INST. OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W.1. "Plain Bearings," Mr. J. Robinson. 6.45 p.m.

TUESDAY, FEBRUARY 28TH.

INST. OF ELECTRICAL ENGINEERS.—North British Station Hotel, Edinburgh. "Present Practical Limits of Power Station Efficiency," Mr. W. S. Burge. 7 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Electric Arc Welding in Ship Construction," Mr. J. L. Adam. 7.30 p.m.

INST. OF FUEL.—Technical College, Green-lane, Derby. "Survey of Modern Tendencies in Boiler Design," Mr. F. Dransfield. 7 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W.1. "Analysis of Crystal Structure by X-rays: A Review of the Work of Twenty Years," Sir Wm. Bragg, F.R.S. 5.15 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Labour and Economic Development in Tropical Africa," Major G. St. John Orde Browne. 4.30 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Some Unusual Methods of Analysis," Mr. T. R. Walker. 7.30 p.m.

WEDNESDAY, MARCH 1ST.

INST. OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "Strong Light Alloys of To-day," Dr. Leslie Aitchison. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: WIRELESS SECTION.—Savoy-place, W.C.2. "Balancing and Stabilising of High-frequency Amplifiers with Special Reference to Power Amplifiers for Radio Transmitters," Messrs. W. Ure, E. J. Grainger, and H. R. Cantelo. 6 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS: GRADUATES.—Bolbec Hall, Newcastle-upon-Tyne. "Welding in Shipbuilding," Mr. N. Milne Hunter. 7.15 p.m.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—Visit to works of United Glass Bottle Manufacturers, Ltd., Charlton, S.E.7. 7.30 p.m.

THURSDAY, MARCH 2ND.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1.—Lecture, "The Zuider Zee Works," Mr. V. J. P. De Blocq van Kuffeler. 6 p.m.

INST. OF MECHANICAL ENGINEERS: N.W. BRANCH.—Engineers' Club, Albert-square, Manchester. "Sydney Harbour Bridge," Mr. L. Ennis. 7.15 p.m.

INST. OF METALS.—University, Edmund-street, Birmingham. "Spectrographic Analysis," Mr. E. H. S. van Someren. 7 p.m.

FRIDAY, MARCH 3RD.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOC.—Visit to British Industries Fair. Luncheon. 12.30 p.m.

INST. OF LOCOMOTIVE ENGINEERS.—Trocadero Restaurant, Shaftesbury-avenue, W.1. Annual dinner. 6.30 for 7 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Modern Steam Propulsion for Ships," to be introduced by Major William Gregson. 7 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W.1. "Disposal of House and Trade Refuse," Mr. J. C. Dawes. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Virtues and Vices of Some Metals," Mr. W. E. W. Millington. 7.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W.1. Discourse by Sir Douglas Mawson. 9 p.m.

SATURDAY, MARCH 4TH.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W.1. "Detection and Production of Swift Particles," Lord Rutherford, F.R.S. 3 p.m.

SUNDAY, MARCH 5TH, TO SUNDAY, MARCH 12TH.

LEIPZIG SPRING FAIR.—Daily.

MONDAY, MARCH 6TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

TUESDAY, MARCH 7TH.

INST. OF AUTOMOBILE ENGINEERS.—In the Hall of the Royal Geographical Society, Kensington Gore, S.W.7. Joint meeting of Kindred Societies. "Some Notes and Observations on Petrol and Diesel Engines," Mr. H. R. Ricardo, F.R.S. The chair will be taken by Sir Joseph Petavel. Mr. H. T. Tizard will open the discussion. 7.30 p.m.

WEDNESDAY, MARCH 8TH.

INST. OF FUEL.—At Chemical Society's Rooms, Burlington House, W.1. "Three Coal Cleaning Processes New to British Practice." 6 p.m.

INST. OF FUEL.—At Engineers' Club, Albert-square, Manchester. "Use of Refractories in the Fuel Industries," Mr. Colin Presswood. 7 p.m.

INST. OF METALS.—Trocadero Restaurant, Piccadilly Circus, W.1. Annual dinner and dance. 7 p.m.

TELEVISION SOCIETY.—University College, Gower-street, W.C.1. "Some Aspects of Television Reception," Mr. T. H. Bridgewater. 7 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Recent Developments in the Warming and Ventilation of Buildings," Mr. J. L. Musgrave. 8 p.m.

WEDNESDAY AND THURSDAY, MARCH 8TH AND 9TH.

INST. OF METALS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. Twenty-fifth annual general meeting. 10 a.m. each day. For papers to be read see page 178.

FRIDAY, MARCH 10TH.

INST. OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Annual dinner. 7 p.m. for 7.30 p.m.

ASSOC. OF EX-SIEMENS' MEN.—Gatti's Restaurant, King William-street, W.C.2. Smoking concert. Particulars and tickets from Mr. J. S. Huddleston, Dagenham Dock, Essex.

INST. OF FUEL.—At Engineers' Club, Albert-square, Manchester. "Design and Operation of Gas, Oil and Electrical Furnaces," Mr. S. N. Brayshaw. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Engineering Achievements in S. Africa," Mr. F. C. Meadows. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Structural Discontinuities," Dr. B. C. Laws. 6 p.m.

MONDAY, MARCH 13TH.

INST. OF METALS.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. Paper, "Welding," Messrs. M. Brownlie and J. Arnott. 7.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

TUESDAY, MARCH 14TH.

INST. OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. "Strong Light Alloys of To-day," Dr. Leslie Aitchison. 7.30 p.m.

INST. OF METALS.—Y.M.C.A., Swansea. "Some Recent Advances in Rolling Mill Practice Abroad," Mr. G. A. V. Russell. 6.15 p.m.

INST. OF METALS.—At Armstrong College, Newcastle-upon-Tyne. Annual general meeting. Discussion, "Testing of Non-ferrous Metals." 7.30 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Joint meeting with Inst. of Electrical Engineers. 39, Elmbank-crescent, Glasgow, C.2. "The Grampian Electric Supply Company's Hydro-electric Developments in the Highlands of Scotland," Messrs. A. S. Valentine, H. M. Gibb, and E. M. Bergstrom. 7.30 p.m.

WEDNESDAY, MARCH 15TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Chemistry of Hydrocarbon Combustion," Prof. W. A. Bone, F.R.S. 8 p.m.

THURSDAY, MARCH 16TH.

INST. OF METALS.—University, Edmund-street, Birmingham. "Metals in the Electrical Industries," Dr. C. J. Smithells, 7 p.m.

INST. OF METALS: LONDON LOCAL SECTION.—In Rooms of Soc. of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W.1. "Recent Developments in Bearing Metals," Mr. A. J. Murphy. 7.30 p.m.

FRIDAY, MARCH 17TH.

CHEMICAL ENGINEERING GROUP.—Joint meeting with Birmingham Section. "Personnel in Industry," Mr. Calder.

EX-BRITISH WESTINGHOUSE ASSOC.—Trocadero. Re-union dinner. Reception, 5.45 p.m.; dinner, 6.45 p.m.

INST. OF METALS.—In Non-ferrous Section of Applied Science Dept. of the University, St. George's-square, Sheffield. Discussion, "Annealing," opener Mr. E. A. Smith. 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—Mayfair Hotel, W. 1. Annual dinner.

MONDAY, MARCH 20TH.

INST. OF AUTOMOBILE ENGINEERS.—Joint meeting with Inst. of Engineers and Shipbuilders in Scotland. 39, Elmbank-crescent, Glasgow. "Problem of Exhaust Silencing and Engine Efficiency," Dr. J. C. Morrison. 7.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

WEDNESDAY, MARCH 22ND.

INST. OF AUTOMOBILE ENGINEERS.—Engineers' Club, Albert-square, Manchester. "Flow in Oil Injection Systems," Dr. S. J. Davies and Dr. E. Giffen. 7 p.m.

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Imperial Hotel, Russell-square, W.C.1. Twenty-sixth annual dinner. 7.15 for 7.30 p.m.

FRIDAY, MARCH 24TH.

INST. OF FUEL.—Technical College, Green-lane, Derby. "Modern Methods of Railway Locomotion," Messrs. C. J. H. Trutch and C. M. Beckett. 7 p.m.

MONDAY, APRIL 3RD.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Lead Burning and Copper and Iron Welding for Plumbers and Heating Engineers," Mr. E. B. Partington. 7.30 p.m.

WEDNESDAY, APRIL 5TH, TO FRIDAY, APRIL 7TH.

INST. OF NAVAL ARCHITECTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2 Seventy-fourth annual meeting. Wednesday, April 5th. Grand Hall, Connaught Rooms, Gt. Queen-street, W.C.2. Annual dinner. 7.30 p.m.

MONDAY AND TUESDAY, APRIL 24TH AND 25TH.

FARADAY SOCIETY.—At the Royal Institution of Great Britain, 21, Albemarle-street, W.1. General discussion, "Liquid Crystals and Anisotropic Melts." Monday, 2.30 p.m.; Tuesday, 10.30 a.m.